this didn't have any number

LATITUDE

OF THE

DETROIT OBSERVATORY,

ANN ARBOR, MICHIGAN,

DETERMINED BY

THE ZENITH TELESCOPE

AND DISCUSSED BY THE

METHOD OF LEAST SQUARES.

BY

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ERRATA.

Page 3. For ΔL read $\Delta \Lambda$.

Page 42. In third normal equation, for -15.580 read $+15.580$.

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DESCRIPTION OF THE INSTRUMENT.

These observations were made with a transit instrument constructed by Fauth & Co., Washington. Settings were made by a graduated circle on the axis, reading to 10″. A zenith-level is attached to this circle. It can be clamped to any point on the limb. The available length of this level is about 3.5 in., or 44 of its own divisions. These are numbered each way from the middle. The tube has an air-chamber in one end. The slow-motion screw, for moving the telescope on its axis, bears against a spiral spring. In cold weather this spring often failed to respond promptly to a motion of the screw.

The object-glass has an available diameter of 3 in., and its focal length is 3 ft. 10 in. Its cell is screwed into the tube of the telescope, and it has no adjusting-pins. Two eye-pieces were used: a diagonal, erecting eye-piece, magnifying to 79 diameters; and a straight, inverting eye-piece, magnifying to 67 diameters. The latter was used almost invariably in observing low stars, and in a few other cases.

The instrument is reversed by two arms which, by means of a lever, lift it out of its wyes. The frame on which it rests stands on a brick pier rising about 3.5 ft. above the ground, and extending two or three feet below it. The whole is inclosed in a small wooden building.

The micrometer-box can be revolved about the axis of the telescope through an angle of 90°. It bears on one side—when it is in its proper position—against an adjustable pin. The micrometer-wire is parallel to the transit-wires. A positive motion of the screw-head brings the wire apparently nearer the screw-head for both eye-pieces. The rule was always to make the last motion of the screw positive. The whole number of

revolutions of the screw was read from a notched scale in the focus, its middle point being numbered 25.

The breadth of the field-of-view is about 30′. The eye-piece can be moved by a rack and pinion across the field. The relative positions of the clamp and the screw-head of the micrometer are thus:

Direction of Star from Zenith.	Position of Clamp.	Position of Screw-Head.
S.	W.	Up.
N.	W.	Down.
S.	E.	"
N.	E.	Up.

The axis of the instrument required adjustment for horizontality only once or twice during the series of observations. This was secured by a striding-level.

Errors of collimation and azimuth were kept within inappreciable limits by observations on a distant terrestrial object. However, during October 11–21 the latter adjustment was in error from the fact that in making observation 12, after reversing, the axis was let down by mistake outside the wyes, so that it was afterwards found to have pushed one of the supporting-posts out of place. Yet, as observations for azimuth were made during this period on stars, the observations for latitude were retained and corrected for this error of azimuth, which was found to be about 25s.

High winds often interfered with the accuracy of the observations, by blowing out the lights. For this reason, notes of the fact have been made.

The centre of the dome of the Detroit Observatory is 75.3 ft. further north than the center of the pier on which the instrument employed in these observations rests.

VALUE OF ONE REVOLUTION OF THE MICROMETER-SCREW.

The value which was used in the separate computations of the latitude was determined by two methods: First, by measuring the difference of declination of two known stars, this difference not being greater than the field of view. The micrometer-wire was set on each in succession without moving the instrument. Second, by observing transits of stars. All the stars used in the first method were taken from the Berliner Jahrbuch. The symbols in the table of reductions denote as follows:

$\Delta\delta$ = difference of declination obtained by means of computed apparent places.

ΔM = difference of zenith-distance, as measured by micrometer.

ΔL = correction to ΔM due to change in the level during the observation.

$\Delta\rho$ = correction to ΔM due to differential refraction.

$\Delta\tau$ = correction to ΔM due to hour-angle of star. This correction is insensible to the third decimal place in every instance but one.

$\Delta\zeta = \Delta M + \Delta L + \Delta\rho + \Delta\tau,$

$R = \Delta\delta \,/\, \Delta\zeta.$

Let m, m' be the micrometer readings for the two stars,
" l, l' " inclinations of the level " " "
" $r' - r$ " difference of refraction " " "
" x, x' " reductions to meridian " " "

all quantities being expressed in terms of R. Then,

micrometer readings increasing upwards,

$$\zeta'-\zeta = (m'-m) \pm (l'-l)+(r'-r) \pm (x'-x) \text{ for } \left\{ \begin{matrix} \text{S.} \\ \text{N.} \end{matrix} \right\} \text{ stars;}$$

micrometer readings increasing downwards,

$$-(\zeta'-\zeta) = (m'-m) \pm (l'-l)-(r'-r) \pm (x'-x) \text{ for } \left\{ \begin{matrix} \text{S.} \\ \text{N.} \end{matrix} \right\} \text{ stars.}$$

In the annexed table $\left\{ \begin{matrix} d \\ u \end{matrix} \right\}$ placed after a micrometer-reading denotes that the readings increase $\left\{ \begin{matrix} \text{downwards} \\ \text{upwards} \end{matrix} \right\}$.

To each value of R thus obtained was assigned the weight, $\frac{1}{20}\, \varDelta M \times$ no. of times observed.

In the second method the determination rests principally on transits of Polaris. The distance of the star from the meridian at each observation was computed by the formula $i = \dfrac{I \cos \delta}{k}$; where

I = observed interval in seconds of time,

δ = star's declination,

$k = \dfrac{I \sin 15''}{\sin I}$,

i = required equatorial interval.

The values were then combined, two and two, for intervals of a given number of revolutions, and the mean of all divided by the number of revolutions in the given interval. The different observations of Polaris were combined by giving to each value of R, thus obtained, the weight $\frac{1}{20}\, rn$, where

r = no. of revolutions in the interval taken,

n = no. of such intervals.

The values of R found from transits of other stars were computed by the formula $i = I \cos \delta$. These values were combined by giving each star the weight $\frac{1}{20}\, srn$, where s depends on the declination of the star and r and n denote as above.

The mean value of R in each case was then compared with the particular value from which it was derived; and by giving

the squares of the residuals the same weights that were used in finding the mean, the probable error, r_0, of each of the three mean values of R was determined. These values were then combined by giving to each a weight proportional to $\frac{n}{\sqrt{r_0}}$; where n denotes the number of observations of weight unity used in determining one of the values.

Value of One Revolution of the Micrometer-Screw, Determined by Measured Differences of Zenith-Distance.

Observations.								Reductions.							
Date.	Stars' Names.	Microm	Level. N.	Level. S.	Mer.	Clamp.	Temp.	Apparent δ.	ΔM	ΔΛ	Δρ	Δτ	Δζ	R.
1886		r	d	d				° ′ ″						
Dec. 7	ι Cass.	8.277	5.8	5.4	[10]s.*	E.	24°.9	+66 53 41.20	r +35.746	r +0.087	r +0.012	r +0.000	r 35.845	″ 45.1660
	Br. 366	44.023	4.0	7.3				67 20 40.13						
8	τ Peg.	48.677d	5.2	6.1	[10]		33.4	23 7 25.09	27.226†	—0.108	0.008	—0.000	27.126	45.1008
	υ Peg.	14.451	2.9	8.4				22 47 1.69						
8	ι Cass.	7.052	0.0	14.6		E.	28.0	66 53 41.43	35.948	—0.026	0.012		35.934	45.0528
	Br. 366	43.000	0.6	14.1				67 20 40.37						
9	κ Peg.	15.198	5.2	6.5		E.	42.0	25 7 43.75	21.407	+0.005	0.006		21.418	45.0091
	16 Peg.	36.605	5.2	6.7				25 23 47.76						
9	τ Peg.	39.717d	5.9	7.1			38.6	23 7 25.03	27.153	—0.045	0.008	+0.000	27.116	45.1112
	υ Peg.	12.564	5.0	8.1	10			22 47 1.64						
9	ι Cass.	44.338	8.1	5.6		W.	33.6	66 53 41.66	35.895	+0.002	0.012		35.909	45.0847
	Br. 366	8.443	8.1	5.7				67 20 40.62						
10	ι Cass.	44.640	7.6	8.2		W.	39.0	66 53 41.88	35.936	+0.014	0.012		35.962	45.0191
	Br. 366	8.704	7.4	8.6				67 20 40.86						

16	35 Ari.	7.565*u*	6.2	6.0			6.0	27 13 30.87	34.554	—0.047	0.010		34.517	45.0207
	41 Ari.	42.119	5.2	7.0				26 47 36.89						
1887 Jan. 5	ι Cass.	44.224	5.8	8.2		W.	14.5	66 53 46.18	35.928	0.000	0.012		35.940	45.0576
	Br. 366	8.296	5.8	8.2				67 20 45.55						
5	ι Persei	35.250*d*	4.3	10.1			12.6	49 10 54.35	22.084	+0.014	0.006		22.104	45.1319
	α Persei	13.166	4.1	10.5				49 27 31.96						
5	σ Persei	17.442*d*	7.0	7.6	[6]		12.2	47 36 17.39	14.466	—0.134	0.004		14.336	44.9944
	δ Persei	31.908	4.1	10.4				47 25 32.35						
7	ι Cass.	43.526	11.2	2.6		W.	4.8	66 53 46.38	35.859	0.026	0.012		35.897	45.1129
	Br. 366	‡ 7.667	10.8	3.3				67 20 45.79						
7	ι Persei	35.726	8.1	6.4		W.	2.7	49 10 54.51	22.162	0.000	0.006		22.168	45.0024
	α Persei	13.564	8.1	6.4				49 27 32.14						
10	35 Ari.	7.694	5.0	9.5		W.	2.3	27 13 31.08	34.530	+0.019	0.010		34.559	44.9657
	41 Ari.	§ 42.224	5.4	9.1				26 47 37.12						
10	ι Persei	35.632	6.6	8.1			1.3	49 10 54.73	22.185	—0.023	0.006		22.168	45.0056
	α Persei	13.447	6.7	8.1		W.		49 27 32.40						

* Numbers in brackets ([]) are doubtful or estimated.
† Micrometer reading changed 7 rev.
‡ Air unsteady. § Air unsteady. Windy.

Value of One Revolution of the Micrometer-Screw, Determined by Measured Differences of Zenith-Distance.

Observations.								Reductions.						
Date.	Stars' Names.	Microm.	Level. N.	Level. S.	Mer.	Clamp.	Temp.	Apparent δ.	ΔM	ΔΛ	Δρ	Δτ	Δζ	R.
1887		r	d	d			°	° ′ ″	r	r	r		r	″
Jan. 10	σ Persei	17.639	7.5	7.3		W.	0.8	+47 36 17.83	+14.244	+0.045	+0.004		14.293	45.1286
	δ Persei	31.883	8.5	6.4				47 25 32.83						
24	ι Cass.	6.239u	4.1	8.4			32.3	66 53 47.18	35.965	0.000	0.012		35.977	45.0220
	Br. 366	42.204	4.1	8.4				67 20 46.94						
24	35 Ari.	42.789d	6.7	6.0			31.7	27 13 30.69	34.502	−0.042	0.010		34.470	45.0811
	41 Ari.	8.287	5.8	6.9				26 47 36.76						
26	ι Cass.	42.908	4.0	13.5		W.	17.8	66 53 47.18	35.990	+0.023	0.012	+0.000	36.025	44.9617
	Br. 366	6.918	4.1	13.7	10			67 20 46.97						
26	35 Ari.	7.159	11.7	6.1	[20]	W.	16.0	27 13 30.61	34.500	+0.012	0.010	−0.002	34.520	45.0157
	41 Ari.	41.659	12.0	5.9				26 47 36.68						
29	ι Cass.	42.999	13.8	1.1		W.	37.2	66 53 47.11	35.877	+0.052	0.012		35.941	45.0706
	Br. 366	7.122	12.8	2.3				67 20 46.98						
29	35 Ari.	8.389	8.1	7.2	5	W.	36.8	27 13 30.45	34.487	+0.019	0.010		34.516	45.0202
	41 Ari.	42.876	8.5	6.8				26 47 36.54						
Feb. 9	σ Persei	17.682	7.3	6.6		W.	36.0	47 36 18.68	14.302	+0.035	0.004		14.341	44.9516
	δ Persei	31.984	8.1	5.9				47 25 34.02						

Values of R Tabulated. I. By Differences of Zenith-Distance.

Stars' Names.	Date.	Temp.	No. of Rev.	R.	Means.	Wt.
ι Cass. Br. 366	1886, Dec. 7	24°.9	36	45″.1660		
	8	28.0	36	45.0528		
	9	33.6	36	45.0847		
	10	39.0	36	45.0191		
	1887, Jan. 5	14.5	36	45.0576		
	7	4.8	36	45.1129		
	24	32.3	36	45.0220		
	26	17.8	36	44.9617		
	29	37.2	36	45.0706		
			324	....	45″.0608	16
τ Pegasi υ Pegasi	1886, Dec. 8	33.4	27	45.1008		
	9	38.6	27	45.1112		
			54	....	45.1060	3
κ Pegasi 16 Pegasi	9	42.0	21	45.0091	45.0091	1
35 Arietis 41 Arietis	16	6.0	35	45.0207		
	1887, Jan. 10	2.3	35	44.9657		
	24	31.7	34	45.0811		
	26	16.0	34	45.0157		
	29	36.8	34	45.0202		
			172	....	45.0207	8
ι Persei α Persei	1887, Jan. 5	12.6	22	45.1319		
	7	2.7	22	45.0024		
	10	1.3	22	45.0056		
			66	....	45.0466	3
σ Persei δ Persei	5	12.2	14	44.9944		
	10	0.8	14	45.1286		
	Feb. 9	36.0	14	44.9516		
			42	....	45.0249	2

Mean value of R from all pairs 45″.0502.

II. By Transits of Polaris.

Date.	Temp.	No. of Rev.	No. of Obs.	R.	Wt.
	°			″	
1886, Oct. 12	80.5	10	14	45.0185	7
19	70.0	6	15	45.0088	4½
20	54.7	10	44	45.0000	22
Nov. 29	18.5	15	26	45.0682	19½
1887, Jan. 3	3.0	10	24	45.1334	12

Mean value of R by Polaris = 45″.0477.

III. By Transits of Other Stars.

Date.	Temp.	Wt. of Star.	No. of Rev.	No. of Obs.	R.	Wt.
	°				″	
1886, Dec. 4.....	6.2	1	42	1	44.7536	2
6.....	22.0	1	13	3	45.0000	2
6.....	19.7	1	40	1	44.9700	2
7.....	25.0	1	20	1	45.2850	1
1887, Jan. 10.....	1.9	1	40	1	45.0000	2
24.....	32.5	1	20	2	44.9550	2
29.....	38.4	1	20	2	44.9550	2
1886, Dec. 8.....	26.8	1	20	2	45.0150	2
9.....	39.6	2	15	5	45.1098	8
9.....	39.0	1	20	2	45.0375	2
9.....	38.6	1	20	2	44.9475	2
9.....	37.5	2	15	3	44.9230	4
1887, Feb. 24.....	30.0	1	20	2	44.9550	2
24.....	25.0	1	20	2	45.0000	2

Mean value of R = 45″.0009.

Determination of R from Preceding Results.

Method.	R.	r_0	$\frac{1}{\sqrt{r_0}}$	No. of Obs.	p	pR.
	″	″				″
$\Delta\delta$	45.0502	0.00295	18.41	33	61	3.0622
Transits of Polaris...	45.0477	.00415	15.51	65	101	4.8177
Transits of Other Stars	45.0009	.01150	9.33	35	33	0.0297
					195)	7.9096
					R =	45.0406

VALUE OF ONE DIVISION OF ZENITH-LEVEL.

This was determined from the number of level-divisions traversed by the bubble while the telescope was turned on its axis through a definite angle. This angle was measured by setting the micrometer-wire on a distant terrestrial object.

Date.	Temp.	D
1886, Oct. 23	40°.5	r 0.04779
		957
		751
		571
Nov. 1	70°.2	457
		590
		905
		792
1887, Feb. 23	34°.7	685
		822
		805
		705
		701
		415
		650

Mean value of D = 0.04705.
r = 0.001023. $r_{\circ}$ = 0.000264.
Taking R = 45''.0406, as previously found, D = 2''.1192.

STAR PLACES.

Of every pair of stars used in determining the latitude one or both are standard stars. Most of them are from the Berliner Jahrbuch; and a few are from the American Nautical Almanac, Connaissance des Temps., and Newcomb's Standard Stars.

The place of every star referred to B. A. C. was computed by reference to the catalogues given below. The weight of the computed star-place was made equal to the weight of the catalogue multiplied by the number of observations; except that to B. A. C. places a weight 1 or 0 was assigned.

Name of Catalogue.	Weight.
Paramatta, 1835,	0
Greenwich Twelve-Year, 1847,	4
Greenwich Appendix II., 1854,	4
Greenwich Appendix I., 1862,	4
Greenwich Observations 1861–'84,	4
B. A. C.,	–
Washington, 1845–'71,	2
Second Radcliffe, 1860,	2
Radcliffe Observations, 1862–'81,	2
Glasgow, Grant,	1
Cape, Stone,	1
Second Armagh,	1
Harvard College, xii.,	2
Argentine, 1886,	1

The names of stars in Paramatta are not always identical with those given in the other catalogues.

The mean places for the beginning of the year were found by the formula:

$$\delta' = \delta_\circ + (t - t_\circ)\, n \text{ Cos. A},$$

where $\delta_\circ =$ the catalogue δ,
$t_\circ =$ the catalogue epoch,
$t \;=$ the year for which δ is required.
$\text{A} = \text{R. A.}$ for epoch $\frac{1}{2}(t + t_\circ)$,
n is taken from the table:

Epoch.	Log n.
1820	1.302280
1830	259
1840	238
1850	217
1860	196
1870	175
1880	154
1890	133

(Annalen der Sternwarte in Wien, Dritter Folge, Erster Band, 1851.)

Proper motions were computed by comparing the annual precession with the given annual variation, in the cases of such stars as were not found in Auwers' Fundamental-Catalog, Newcomb's Standard Stars, or other trustworthy authorities.

The apparent places for the time of observation were in every case computed by the formula

$$\delta = \delta' + g \cos (G + a') + h \cos (H + a') \sin \delta' + i \cos \delta + t\mu',$$

the star-numbers being all taken from the Berliner Jahrbuch.

Mean Places of Stars Other than Standard.—B. A. C. 7657, η Piscis Australis.

Catalogue.	Epoch.	Wt.	N. P. D., 1886.0		
Paramatta*	1825	0	°	′	″
B. A. C.	1850	1	119	0	0.71
Washington	1860	8			2.02
Greenwich, Appendix I.	1860	68			1.93
" Observations	1861	32			1.04
" "	1862	4			3.20
" "	1863	12			2.96
" "	1865	20			1.36
" "	1866	4	118	59	59.31
" "	1867	44	119	0	0.43
" "	1868	52	118	59	58.04
" "	1869	28			58.60
" "	1870	28			58.61
" "	1871	4			59.04
" "	1873	8	119	0	0.37
" "	1875	4	118	59	58.81
Argentine	1875	3			59.85
Harvard College	1875	34	119	0	0.58
Greenwich Observations	1876	12	118	59	57.81
" "	1878	8	119	0	1.23
" "	1880	4			0.49
Radcliffe	1880	2			1.43
Cape	1880	3			0.40
Greenwich Observations	1882	16			1.26
" "	1883	8			1.56
" "	1884	4			2.11
Proper motion	....	......			0.00
Adopted mean place	....	......	119	0	0.86

* "κ Pisc. Austr."

B. A. C. 7930, 20 Piscis Australis.

Catalogue.	Epoch.	Wt.	N. P. D., 1886.0		
			°	′	″
Greenwich 12-year	1845	12	115	50	11.38
B. A. C.	1850	1			7.70
Washington	1860	4			9.11
Radcliffe	1863	4			10.66
"	1864	2			9.95
"	1865	2			9.74
Argentine	1875	4			9.17
Second Armagh	1875	3			11.97
Greenwich Observations	1877	8			9.86
" "	1878	12			10.05
Cape	1880	3			9.73
Proper motion	....	......			0.00
Adopted mean place	....	......	115	50	10.25

B. A. C. 7987, δ Piscis Australis.

Catalogue.	Epoch.	Wt.	N. P. D., 1886.0		
Paramatta*	1825	0	123	8	51.4
Greenwich, 12-year	1845	4			56.46
B. A. C.	1850	0			50.78
Greenwich Appendix II.	1850	16			50.12
Washington	1860	4			53.18
Argentine	1875	7			53.16
Cape	1880	3			54.38
Radcliffe	1880	2			56.56
Greenwich Observations	1883	8			58.90
Proper motion taken from Cape	....	......			— 0.09
Adopted mean place	....	......	123	8	54.06

* "η Pisc. Austr."

B. A. C. 8195, 14 Andromedæ.

Catalogue.	Epoch.	Wt.	N. P. D., 1886.0		
			°	′	″
B. A. C.	1850	0	51	23	21.58
Washington	1860	4			23.49
Second Radcliffe	1860	12			22.99
Greenwich Observations	1865	4			24.33
" "	1866	8			24.26
Glasgow	1870	5			22.92
Radcliffe	1871	4			21.82
Greenwich Observations	1871	4			23.15
" "	1872	12			22.80
Radcliffe	1872	2			23.13
"	1873	4			22.56
Greenwich Observations	1873	16			23.37
" "	1874	16			23.36
" "	1876	8			23.16
" "	1878	4			22.65
" "	1879	8			24.21
" "	1880	4			23.54
" "	1881	4			22.46
Annual proper motion computed from Greenwich Observations	....	......			+ 0.05
Adopted mean place	....	......	51	23	23.25

B. A. C. 8348, Sculptoris.

B. A. C.	1850	1	127	51	44.37
Argentine	1875	5			46.89
Cape	1880	3			48.39
Proper motion	....	......			0.00
Adopted mean place	....	......	127	51	47.11

B. A. C. 79, Cassiopeiæ.

Catalogue.	Epoch.	Wt.	N. P. D., 1886.0		
			°	′	″
B. A. C.	1850	1	38	36	43.30
Greenwich Observations	1864	20			42.91
Glasgow	1870	3			44.03
Proper motion	......	......			0.00
Adopted mean place	......	......	38	36	43.07

B. A. C. 192, λ^1 Sculptoris.

Catalogue.	Epoch.	Wt.	°	′	″
Paramatta		0	129	5	15.10
B. A. C.	1825	0			15.55
Washington	1850	4			18.36
Argentine	1860	4			18.30
Cape	1875	3			18.28
Proper motion	......	......			0.00
Adopted mean place	......	......	129	5	18.32

B. A. C. 202, λ^2 Sculptoris.

Catalogue.	Epoch.	Wt.	°	′	″
Paramatta	1825	0	129	3	0.24
B. A. C.	1850	0			1.62
Washington	1860	4			0.33
Argentine	1875	4			0.05
Cape	1880	3			0.37
Proper motion from B. A. C.	......	......			—0.08
Adopted mean place	......	......	129	3	0.24

B. A. C. 307, ψ^1 Piscium.

Catalogue.	Epoch.	Wt.	°	′	″
B. A. C.	1850	0	69	8	14.17
Second Radcliffe	1860	10			15.26
Greenwich Observations	1864	16			15.38
Radcliffe	1865	2			15.24
"	1866	0			11.29

B. A. C. 307, ψ^1 Piscium.

Catalogue.	Epoch.	Wt.	N. P. D., 1886.0		
			°	′	″
Greenwich Observations....	1866	4	69	8	16.49
Radcliffe........................	1867	2			14.51
Proper motion from Greenwich Obs.....	....	......			+0.02
Adopted mean place..................	....	......	69	8	15.43

B. A. C. 341, Piscium.

Catalogue.	Epoch.	Wt.	°	′	″
B. A. C...............................	1850	0	74	56	10.29
Second Radcliffe......................	1860	6			3.31
Greenwich Appendix I..................	1860	32			3.09
Glasgow...............................	1870	7			0.57
Greenwich Observations................	1880	12		55	59.42
" "	1881	12			59.73
Proper motion from Greenwich Obs.....	....	......			+0.17
Adopted mean place..................	....	......	74	56	1.60

B. A. C. 492, χ Andromedæ.

Catalogue.	Epoch.	Wt.	°	′	″
B. A. C........................	1850	0	46	11	40.09
Greenwich Observations...	1864	4			39.32
" "	1866	8			39.18
Radcliffe	1880	2			42.51
"	1881	2			39.15
"	1881	6			39.51
Proper motion.........................	....	......			0.00
Adopted mean place..................	....	......	46	11	39.60

B. A. C. 923, Fornacis.

Catalogue.	Epoch.	Wt.	°	′	″
B. A. C...............................	1850	0	125	50	4.40
Cape..................................	1880	3			0.15
Proper motion.........................	....	......			0.00
Adopted mean place..................	....	......	125	50	0.15

OBSERVATIONS FOR LATITUDE.

The method pursued was as follows. Before the time for the appearance of the first star the telescope was set for the mean zenith-distance of the two stars. The micrometer-wire was set where the star would enter the field, and the star was bisected in the middle of the field. The readings of the scale, screw-head, and level were then recorded. The instrument was then reversed and the process repeated for the second star; the telescope having been set by bringing the bubble of the zenith-level to the middle of its tube.

In case the bisection was made at one side of the middle of the field, the interval was either observed by a chronometer or computed from the estimated position of the star in the field. Values of the latter kind are placed in brackets.

The values of the latitude were computed by the formula:

$$\phi = \tfrac{1}{2}(\delta' + \delta) \pm \tfrac{1}{2}(m' - m)R + \frac{(n' + n) - (s' + s)}{4}D + \tfrac{1}{2}(r - r') + (x' + x),$$

the $\left\{ \begin{matrix} \text{upper} \\ \text{lower} \end{matrix} \right\}$ sign being used when the micrometer-readings increase $\left\{ \begin{matrix} \text{downwards} \\ \text{upwards} \end{matrix} \right\}$; and

$\left\{ \begin{matrix} \delta' \\ \delta \end{matrix} \right\}$ = the declination of the $\left\{ \begin{matrix} \text{N.} \\ \text{S.} \end{matrix} \right\}$ star,

$\left\{ \begin{matrix} m' \\ m \end{matrix} \right\}$ = the micrometer reading for $\left\{ \begin{matrix} \text{N.} \\ \text{S.} \end{matrix} \right\}$ star,

$\left\{ \begin{matrix} n', s' \\ n, s \end{matrix} \right\}$ = the level-readings for " "

R = value of one revolution of the micrometer-screw, expressed in arc,
D = value of one division of the level, expressed in arc,
$r - r'$ = the difference of refraction,
x', x = the meridian corrections.

For pairs north of the equator $r - r'$ was taken equal to $\pm (m' - m)\dfrac{dr}{dz}$; the double sign denoting as above, and $\dfrac{dr}{dz} = \dfrac{a \sin 1'}{\cos^2 z}$.*

*Chauv. Astron., ii, p. 345.

For stars below the equator $r - r'$ was found from tables prepared for that purpose and taking account of the indications of barometer and thermometer.

The meridian corrections were found by the formula

$$x = [6.1347]\ \tau^2 \sin 2\delta;*$$

except in reducing the observations of October 11–21, for which the formula used is

$$x = \pm [6.4357]\ \tau^2 \frac{\cos\phi \cos\delta}{\sin z} \text{ for a } \left\{ \begin{matrix} \text{N.} \\ \text{S.} \end{matrix} \right\} \text{ star}$$

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* Chauv. Astron. ii., p. 347.

Observations for Latitude. *Reductions.*

No.	Date.	Stars' Names.	Microm.	Level. N.	Level. S.	Mer.	Cl.	Barom. at Therm.	Apparent δ and δ′	Corrections. Microm.	Corrections. Level	Corrections. Refr.	Corrections. Mer.	Seconds of Lat.
	1886		r	d	d	sec.		i	° ′ ″	′ ″	″	″		″
1	Oct. 6	61 Cygni pr.	38.085	6.3	5.9		W.	29.245	+38 11 53.83	+9 17.06	+6.57	+0.15		44.53
		g Cygni	13.349	12.4	0.4			57.0°	46 2 47.68					
2	6	20 Pegasi	19.562	8.3	5.1		E.		12 34 51.68	+5 42.33	+3.23	+0.12		49.65
		24 Cephei	34.763	8.1	5.2				71 47 16.27					
3	6	31 Pegasi	20.590	9.0	4.4		W.		11 38 16.30	—4 6.68	—0.48	—0.09		47.33
		31 Cephei	31.544	4.0	9.5				73 3 32.87					
4	6	λ Pegasi	24.993	8.2	5.2	4	E.		22 58 22.89	—2 14.38	—2.70	—0.04		48.75
		τ Pegasi	37.140	10.6	3.3		E.	29.240	23 7 22.72	—6 47.93	—0.42	—0.12		47.31
		4 Cass.	19.026	2.9	11.0			54.0	61 39 48.85					
5	7	γ Cygni	17.867	6.7	4.2				39 54 2.97	—6 38.29	—2.70	—0.11		48.13
		α Cygni	35.553	2.0	9.6				44 52 55.50					
6	7	Br. 2749	41.257	5.9	6.0				80 7 59.00	—10 42.71	—0.37	—0.28		46.45
		α Equulei	12.718	6.2	6.8		W.	29.270 62.5	4 47 0.62					
7	7	20 Pegasi	34.024	7.6	2.7				12 34 51.74	+5 38.65	+4.98	+0.12		47.89
		24 Cephei	18.986	7.4	2.9				71 47 16.54					

Observations for Latitude. *Reductions.*

No.	Date.	Stars' Names.	Microm	Level. N.	Level. S.	Mer.	Cl.	Barom At. Therm.	Apparent δ and δ′	Corrections. Microm.	Corrections. Level.	Corrections. Refr.	Corrections. Mer.	Seconds of Lat.
	1886		r	d	d	sec.		i	° ′ ″	′ ″	″	″	″	″
8	Oct. 8	γ Cygni	34.536	4.1	5.9			29.280	+39 54 3.04	—6 40.39	—0.64	—0.11		48.18
		α Cygni	16.757	5.5	4.9			67.0	44 52 55.60					
9	8	6 H. Ceph.	16.495	6.0	4.2	6			57 10 47.29	—7 30.87	—2.49	—0.13		48.48
		32 Vulpec.	36.516	4.3	10.8				27 37 56.66					
10	8	ν Cygni	12.101	5.5	4.7	23			40 44 14.17	+10 13.72	—0.69	+0.17	+0.07	47.93
		ξ Cygni	39.353	4.0	6.1				43 28 55.16					
								29.280 64.0						
11	9	π Sagitt.	23.377	7.2	3.2		W.	29.305 70.1	—21 12 3.18	—0 48.68	—0.32	—0.06	—0.01	46.60
		Gr. 1374, S. P.	25.539	3.5	8.1	10		69.5	+105 47 14.52					
12	11	π Sagitt.**	25.926	5.5	5.4	6	E.	29.260 73.5	—21 12 3.22	—0 46.28	—0.05	—0.06	—0.47	48.88
		Gr. 1374, S. P.	23.871	5.8	6.0	5		71.0	+105 47 14.70					
13	11	6 H. Ceph.	37.807	4.4	6.2				57 10 47.65	—7 35.70	—0.11	—0.13	—0.01	46.33
		32 Vulpec.	17.572	6.2	4.6	3			27 37 56.92					

14	11	Gr. 3415	21.212	5.7	5.2		W.	67.0	59	31	37.24	−2	51.69	0.00	−0.05	+0.03	49.41
		κ Pegasi	28.836	5.5	6.0				25	7	45.01						
15	12	ω Aquilæ†	28.235	7.2	4.1	[18]	E.	29.265 73.5	11	23	48.47	+0	17.60	+0.11	+0.01	−0.15	46.29
		τ Dracon.	29.017	4.2	7.1				73	9	8.98						
16	12	6 H. Ceph.	15.293	5.7	3.0	[32]	W.		57	10	47.78	−7	38.46	+3.39	−0.13	+0.14	47.32
		32 Vulpec.	35.651	6.2	2.5			68.0	27	37	56.98						
17	12	31 Peg. ‡	3.294	5.3	5.7		E.		11	38	16.59	−5	29.08	−0.69	−0.12	+0.16	′ ″ (15 25.86*)
		31 Cephei	17.907	5.0	5.9				73	3	34.59						
18	12	α Pisc. Austr. §	12.263	3.0	4.2	[10]	W.		−30	13	20.43	−8	1.10	−1.11	−1.39	−0.56	47.86
		Gr. 1771, S. P.	33.626	2.4	3.3			29.140 63.0	+115	3	4.47						
19	13	ω Aquilæ	26.881	10.9	8.5		E.	29.005 74.5	11	23	48.45	+0	24.54	−4.93	+0.01	+0.07	48.41
		τ Dracon.	27.971	3.6	16.3	10			73	9	9.00						
20	13	γ Cygni	34.207	6.0	6.2	5.5	E.		39	54	3.34	−6	41.98	−0.42	−0.11	−0.17	47.02
		α Cygni	16.357	6.0	6.6				44	52	56.06						
21	13	ν Cygni	40.692	5.8	6.7		W.	68.0	40	44	14.66	+10	12.73	−0.37	+0.17		47.72
		ξ Cygni	13.484	6.4	6.2				43	28	55.72						

** Frame shifted in reversing. See p. 2. † First observation poor. Hazy. ‡ Setting by zenith-circle, 30° 40′ 20″ § Air unsteady.
* Probably wrong star observed.

Observations for Latitude. *Reductions.*

No.	Date.	Stars' Names.	Microm.	Level. N.	Level. S.	Mer.	Cl.	Barom. At. Therm.	Apparent δ and δ'	Corrections. Microm.	Corrections. Level.	Corrections. Refr.	Corrections. Mer.	Seconds of Lat.
	1886		r	d	d	sec.			° ′ ″	′ ″	″	″	″	″
22	Oct. 13	Gr. 3415	32.440	7.0	5.7		E.		+59 31 37.55	—2 52.86	—0.64	—0.05	+0.03	47.84
		κ Pegasi *	24.764	5.4	7.9			i	25 7 45.18					
23	19	γ Cygni	17.597	5.3	7.3			29.390	39 54 3.56	—6 43.27	—0.16	—0.11		46.47
		α Cygni	35.504	7.8	6.1			65.0	44 52 56.46					
24	19	6 H. Ceph.	37.547	8.3	5.8				57 10 48.46	—7 34.48	—0.37	—0.13	—0.06	47.82
		32 Vulpec.	17.366	5.5	8.7	[6]			27 37 57.27					
25	19	ν Cygni	40.393	7.9	6.2	[5]			40 44 15.11	+10 13.43	—0.32	+0.17	+0.01	48.97
		ξ Cygni	13.154	6.0	8.3	6			43 28 56.25					
26	19	Gr. 3415	32.429	8.3	6.2	[4]	E.		59 31 38.36	—2 55.04	—0.16	—0.05		46.71
		κ Pegasi	24.656	6.3	8.7			29.375 60.5	25 7 45.57					
27	19	20 Pegasi†	33.895	8.3	6.8				12 34 52.17	+5 42.35	—0.11	+0.12	—0.01	48.20
		24 Cephei	18.693	6.7	8.4	18	E.		71 47 19.49					
28	21	σ Cygni ‡	8.926	7.6	4.3		W.		38 55 33.54	—12 25.19	0.00	—0.21		46.20
		g Cygni	42.016	4.4	7.7			29.350 50.0	46 2 49.66					

29	21	31 Pegasi	29.000	5.7	5.4	[4]			11	38	16.84	—6	3.68	—0.05	—0.14	—0.07	(14 52.95[1])
		31 Ceph. §	12.841	5.4	5.8	[25]			73	3	36.94						
30	21	ζ Pegasi	7.668	6.2	4.6				10	14	35.37	—13	52.15	+1.01	—0.32	+0.16	49.21
		π Cephei	44.619	5.7	5.4		E.		74	46	45.65						
31	21	τ Pegasi	35.886	6.3	5.0		E.	i	23	7	24.35	—6	51.42	—0.85	—0.13	+0.24	46.54
		4 Cass.**	17.617	4.2	7.1	[47.5]		29.335 47.°0	61	39	53.06						
32	22	γ Cygni	16.932	7.5	7.2			29.250 60.0	39	54	3.62	—6	43.69	+0.90	—0.11		47.20
		α Cygni ††	34.858	8.3	6.9				44	52	56.59						
33	22	6 H. Ceph.	32.965	7.1	8.1				57	10	48.67	—7	34.89[2]	+0.05	—0.13		48.03
		32 Vulpec.	17.766	8.1	7.0	3			27	37	57.34						
34	22	ν Cygni	42.248	6.9	8.3				40	44	15.27	+10	11.63	—1.06	+0.17		46.61
		ξ Cygni	15.089	7.4	8.0				43	28	56.47						
35	22	Gr. 3415	29.393	8.2	7.3	[5]			59	31	38.70	—2	54.23	—0.32	—0.05		47.61
		χ Pegasi	21.656	7.1	8.6		W.	58.5	25	7	45.72						
36	22	20 Pegasi	34.019	7.1	8.6				12	34	52.23	+5	42.83[3]	—0.48	+0.12		48.65
		24 Cephei	28.796	8.3	7.7				71	47	20.14						
37	22	31 Pegasi	32.198	8.7	7.4				11	38	16.87	—4	13.69	+4.88	—0.09		48.12
		31 Cephei	20.933	12.1	4.2		W.	55.0	73	3	37.18						

* Hazy. Moonlight. † Very faint. ‡ Con. des Temps § Faint, and seemed early. ** 2 s. from edge of field. †† Atmos. conditions good

[1] Probably wrong star observed. [2] Microm. changed 5 rev. [3] Microm. changed 10 rev.

Observations for Latitude. *Reductions.*

No.	Date.	Stars' Names.	Microm.	Level. N.	Level. S.	Mer.	Cl.	Barom. At. Therm.	Apparent δ and δ'	Corrections. Microm.	Corrections. Level.	Corrections. Refr.	Corrections. Mer.	Seconds of Lat.
	1886		r	d	d	sec.			° ' ''	' ''	''	''		''
38	Oct. 22	α Pisc. Austr.	36.886	7.7	8.9		E.		—30 13 21.91	—8 8.80	+3.97	—1.45		46.63
		Gr. 1771 S. P.	15.181	12.8	4.1				+115 3 7.74					
39	23	γ Cygni	16.984	7.0	6.4			i 29.200	39 54 3.62	—6 42.21	−0.37	—0.11		47.43
		α Cygni	34.844	6.3	7.6			58°.5	44 52 56.63					
40	23	6 H. Ceph.	38.048	6.9	7.1				57 10 48.74	—7 35.47	+0.26	—0.13		47.71
		32 Vulpec.	17.823	7.4	6.7				27 37 57.36					
41	23	ν Cygni	38.961	7.6	6.2	[4]			40 44 15.32	+10 13.38	—0.11	+0.17		49.36
		ξ Cygni	11.724	6.2	7.8		E.	29.290 56.5	43 28 56.52					
42	30	Gr. 3415	20.984	7.1	5.7		W.		59 31 39.36	—2 54.86	0.00	—0.05		47.75
		κ Pegasi	28.749	5.7	7.1			29.330 50.5	25 7 45.97					
43	30	20 Pegasi	18.694	4.5	7.1				12 34 51.95	+5 40.49	+0.37	+0.12		47.77
		24 Cephei	33.813	7.5	4.2				71 47 21.63					
44	30	31 Pegasi	20.981	7.1	4.6				11 38 16.91	—4 10.24	+0.16	—0.09		47.76
		31 Cephei	32.093	4.9	7.1				73 3 38.95					

45	30	α Pisc. Austr.	41.626	6.7	5.4		E.		—30	13	23.02	—8	8.22	+3.55	--1.45			47.49
		Gr. 1771, S. P.	19.947	9.0	3.6	10		29.315 46.0	+115	3	10.20							
46	30	α Androm.	33.275	6.9	5.9				28	28	4.03	+5	13.70	—0.32	+0.09			48.79
		α Cass.	19.345	5.9	7.5			29.305 45.0	55	55	6.62							
47	Nov. 3	τ Aquilæ*	18.137	7.0	7.4				6	57	46.60	+6	34.77	—0.37	+0.16			46.58
		κ Cephei	35.667	7.1	7.4		W.		77	22	37.44							
48	3	20 Pegasi	18.897	5.9	6.5			28.910 52.0	12	34	52.20	+5	40.80	—0.79	+0.12			47.36
		24 Cephei†	34.030	5.8	6.7			28.940 50.0	71	47	22.27							
49	3	31 Pegasi	21.436	5.7	6.7				11	38	16.89	—4	8.84	+0.11	—0.09			49.48
		31 Cephei	32.486	7.0	5.8				73	3	39.72							
50	3	γ Cephei	14.919	2.5	7.2				77	0	15.76	—9	4.29	+0.48	—0.22			48.80
		c^2 Pisc.‡	39.088	8.2	2.6			28.955 45.5	7	51	29.90							
51	6	ν Cygni	13.121	6.2	5.8				40	44	15.43	+10	12.35	—1.17	+0.17			47.47
		ξ Cygni	40.312	4.8	7.4				43	28	56.81							
52	6	20 Pegasi	34.337	6.3	7.0	10		29.090 32.0	12	34	52.13	+5	44.85	—4.13	+0.12	+0.01		48.25
		24 Cephei	19.024	3.1	10.2	5			71	47	22.67							

* Am. Naut. Al. Both stars well observed. † High wind ‡ Newcomb's St. Stars.

Observations for Latitude. *Reductions.*

No.	Date.	Stars' Names.	Microm.	Level. N.	Level. S.	Mer.	Cl.	Barom. At. Therm.	Apparent δ and δ'	Corrections. Microm.	Corrections. Level.	Corrections. Refr.	Corrections. Mer.	Seconds of Lat.
	1886		r	d	d	sec.			° ′ ″	′ ″	″	″		″
53	Nov. 6	31 Pegasi	32.024	4.9	8.6		E.		+11 38 16.83	-4 12.70	−0.95	−0.09		44.80
		31 Cephei	20.803	7.7	5.8				73 3 40.25					
54	6	α Pisc. Austr.	40.244	6.4	7.3		E	i 31.0	−30 13 23.91	−8 6.44	−0.21	−1.48		46.03
		Gr. 1771 S. P.	18.643	7.1	6.6				+115 3 12.24					
55	6	γ Cephei	14.620	7.6	6.2		W.		77 0 16.53	−9 6.47	+0.48	−0.22		46.99
		c^2 Piscium	38.886	6.8	7.3			29.065 32.0	7 51 29.87					
56	8	γ Cygni	35.918	5.0	6.3			29.075 36.5	39 54 3.06	−6 41.78	−0.21	−0.11		47.68
		α Cygni	18.077	6.2	5.3		W.		44 52 56.50					
57	8	6 H. Ceph.	14.605	5.9	5.6				57 10 48.99	−7 36.17	+0.79	−0.13		47.52
		32 Vulpec.	34.861	6.4	5.2				27 37 57.07					
58	8	ν Cygni	12.554	4.0	7.7				40 44 15.36	+10 10.93	0.00	+0.17	+0.04	47.21
		ξ Cygni	39.682	7.7	4.0				43 28 56.78					
59	8	Gr. 3415	21.156	5.4	6.2			35.5	59 31 39.69	−2 55.74	+0.32	−0.05		47.38
		κ Pegasi	28.960	6.8	5.4		E.	34.0	25 7 46.01					

60	8	31 Pegasi	21.066	7.0	5.3	[10]	W.		11	38	16.78	—4	10.63	—0.48	—0.09	+0.01	47.48
		31 Cephei	32.195	4.9	7.5				73	3	40.56						
61	8	α Pisc. Austr.*	38.173	4.9	9.8				—30	13	24.17	—8	4.91	—0.69	—1.47		47.24
		Gr. 1771, S. P.	16.641	9.1	5.5				+115	3	12.80						
62	8	γ Cephei	14.744	6.1	8.6			32.0	77	0	17.03	—9	5.78	+0.05	—0.22		47.48
		c^2 Piscium	38.979	8.7	6.1				7	51	29.83						
63	8	α Androm†	18.234	5.9	9.0				28	28	4.84	+5	12.78	—0.85	+0.09		48.81
		α Cass.	32.123	8.2	6.7		W.	29.060 29.170 33.5	55	55	8.74						
64	13	20 Pegasi	17.307	7.0	6.1				12	34	51.90	+5	40.01	+0.21	+0.12		48.02
		24 Cephei	32.405	6.9	7.4				71	47	23.46						
65	13	τ Pegasi	35.701	6.8	7.1				23	7	25.58	—6	55.34	+1.06	—0.13		47.30
		4 Cass.	17.258	8.1	5.8				61	39	57.85						
66	13	γ Cephei	14.534	9.0	5.0	[52]			77	0	18.19	—9	5.48	+0.90	—0.22	+0.16	49.31
		c^2 Piscium	38.756	5.8	8.1				7	51	29.71						
67	15	B. A. C. 7657 ‡	21.508	5.2	5.4			29.170 29.5 29.370	—28	59	50.06	—9	15.78§	0.00	—1.47		47.37
		30 H. Urs. maj., S.P.	43.829	6.4	6.2			36.5	+113	51	59.30						

* Setting 72° 35′. † Not well bisected. ‡ Poorly observed—cloudy. § Microm. changed to 6.829, 2d star.

Observations for Latitude. *Reductions.*

No.	Date.	Stars' Names.	Microm	Level. N.	Level. S.	Mer.	Cl.	Barom At. Therm.	Apparent δ and δ′	Corrections. Microm.	Corrections. Level.	Corrections. Refr.	Corrections. Mer.	Seconds of Lat.
	1886		r	d	d	sec.			° ′ ″	′ ″	″	″	″	′ ″
68	Nov. 15	35 H. Urs. maj., S.P.	31.436	6.2	6.7				+110 20 13.31	+1 37.92	0.00	+0.21		45.57
		B. A. C. 7930	27.088	6.7	6.2	[15]			—25 49 58.42					
69	15	B. A. C. 7987	24.012	5.8	7.1				—33 8 44.63	+2 13.75	0.00	+0.57	+0.01	(17 6.21)
		α Urs. maj., S.P.	29.951	7.1	5.8	[8]		i 34.5	+117 38 31.68					
70	15	τ Pegasi *	10.254	6.9	6.1				23 7 25.61	—9 29.22	0.00	—0.17		(14 12.48†)
		4 Cass.	35.530	6.1	6.9				61 39 58.14					
71	15	α Androm	34.098	7.4	5.9				28 28 5.32	+5 10.04	—0.58	+0.09	+0.22	47.53
		ε Androm	15.592	8.4	5.2				28 41 56.83	—1 46.73	+0.32	—0.03	+0.22	47.29
		α Cass.	20.331	5.5	8.1	[42]			55 55 10.20					
72	19	Gr. 3415	30.743	8.2	3.1			29.020 32.0	59 31 39.48	—2 55.22	—0.95	—0.05		46.30
		κ Pegasi	22.962	2.3	9.2				25 7 45.57					
73	Dec. 4	B. A. C. 7657	30.587	4.4	7.4	21	E.	29.540 14.2	—28 59 50.94	—9 13.91	—3.23	—1.53	—0.05	46.63
		30 H. Urs. maj., S.P.	5.991	3.4	6.5				+113 52 1.65					

74	4	B. A. C. 8195	28.150	6.2	5.9				38	37	7.26	+2	49.95§	—5.30	+0.05		46.94
		λ Androm.	29.559	0.6	10.9			9.8	45	50	57.23						
75	6	20 Pegasi	32.827	1.5	8.2			29.320	12	34	50.27	+5	41.18	—0.21	+0.12		48.21
		24 Cephei	17.677	8.3	2.0		E.	28.0	71	47	23.97						
76	6	31 Pegasi‡	30.871	0.8	9.7	[30]	E.		11	38	15.19	—4	14.97	—0.53	—0.09	+0.05	43.41
		31 Cephei	19.549	9.3	1.4			26.5	73	3	42.71						
77	6	B. A. C. 7987	30.539	7.0	4.4				—33	8	46.27	+1	53.70	+1.59	+0.51		48.77
		αUrs.maj., S. P.	25.490	7.4	7.0			25.0	+117	38	35.50						
78	6	τ Pegasi	34.574	4.0	6.9				23	7	25.19	—6	53.24	+1.59	—0.13		47.64
		4 Pegasi	16.224	5.4	5.5		W.		61	40	0.02						
79	6	B. A. C. 8195	29.648	0.6	10.3		W.		38	37	7.24	+2	44.76	+0.95	+0.05		48.00
		λ Androm.	22.332	11.3	-0.2				45	50	57.25						
80	6	Br. 82	28.385	5.4	4.9				63	38	6.23	+1	41.92	+1.38	+0.03		49.07
		B. A. C. 307, pr.	23.859	6.2	4.1			21.5	20	52	5.26						
81	6	φ Persei	26.132	4.9	5.6				50	7	13.84	—0	23.31	+1.01	—0.01		49.42
		β Trian.	27.167	6.6	4.0			29.285 20.0	34	27	9.62						

* Faint. † Probably wrong star observed. See No. 84. ‡ Near edge of field. § Microm. changed 9 rev.

Observations for Latitude. — *Reductions.*

No.	Date.	Stars' Names.	Microm.	Level. N.	Level. S.	Mer.	Cl.	Barom. At. Therm.	Apparent δ and δ'	Corrections. Microm.	Corrections. Level.	Corrections. Refr.	Corrections. Mer.	Seconds of Lat.
	1886		r	d	d	sec.		°	° ′ ″	′ ″	″	″		″
82	7	35 H. Urs. maj., S.P.	30.052	2.7	6.2			27.5	+110 20 16.33	+1 42.94	—3.44	+0.23		47.88
		B. A. C. 7930	25.481	2.6	5.6				—25 50 0.03					
83	7	B. A. C. 7987	23.432	4.4	5.5				—33 8 46.31	+1 52.28	+0.53	+0.51		46.34
		αUrs. maj., S. P.	28.418	7.0	4.9		W.		+117 38 35.63					
84	7	τ Pegasi*	10.037	6.1	6.0		W.		23 7 25.15	—9 30.39	0.00	—0.17		′ ″ (14 12.04†)
		4 Cass.	35.365	6.0	6.1				61 40 0.05					
85	7	B. A. C. 8195	24.015	6.1	5.9				38 37 7.22	+2 46.06	—0.64	+0.05		47.70
		λ Androm.	31.389	5.3	6.7			29.185	45 50 57.24					
86	7	Br. 82	28.460	5.3	5.8				63 38 6.38	+1 41.74	+0.05	+0.03		47.63
		B. A. C., 307, pr.	23.942	5.9	5.3				20 52 5.25					
87	7	B. A. C. 341	35.493	6.2	5.2			25.2	15 4 16.98	—5 56.27	+1.06	—0.12		46.27
		38 Cass.	19.673	6.0	5.0			29.150 36.8	69 41 6.22					
88	8	20 Pegasi	19.124	8.1	2.2				12 34 50.08	+5 42.02	—0.11	+0.12		49.01
		24 Cephei	34.311	2.1	8.2				71 47 23.88					

89	8	31 Pegasi	20.481	7.4	3.0			35.0	11	37	15.01	—4	9.29§	—1.01	—0.09		48.46
		31 Cephei‡	26.551	2.2	8.5			29.235	73	3	42.69						
90	8	B. A. C. 8195	23.137	5.9	5.4			31.8	38	37	7.19	+2	46.42	—1.17	+0.05		47.52
		ζ Androm.	30.527	4.3	7.0				45	59	57.26						
91	8	B. A. C. 8348	28.364	6.3	5.2				—37	51	42.53	+2	21.68	—0.48	+1.21		47.52
		δ Urs. maj., S. P.	22.073	5.0	7.0				+122	20	32.76						
93	8	ε Androm.	27.639	3.8	8.1				28	41	57.65	—1	43.59	—1.06	—0.03		50.90
		α Cass.	23.039	7.1	4.8				55	55	13.52						
94	8	φ Persei	24.627	8.5	5.7				50	7	14.10	—0	24.48	+0.11	—0.01		47.18
		β Triang.	25.714	6.0	8.6			29.240 28.5	34	27	9.63						
95	9	20 Pegasi	18.537	5.9	6.2				12	34	49.98	+5	41.79	—0.32	+0.12		48.49
		24 Cephei	33.714	6.0	6.3		W.		71	47	23.82						
96	9	31 Pegasi	20.137	7.1	5.2	25	W.		11	38	14.93	—4	4.50	—0.85	—0.09	+0.03	53.36
		31 Cephei	31.094	4.6	8.1			29.250 39.0	73	3	42.67						
97	9	B. A. C. 8195	21.116	6.9	6.2				38	37	7.18	+2	45.28	—0.11	+0.05	—0.03	47.44
		ζ Androm.	28.455	6.1	7.0				45	50	57.26						

* Very faint. Both stars well bisected. † Probably wrong star observed. See obs 70. ‡ Stars very steady § Microm. changed 5 rev.

Observations for Latitude. *Reductions.*

No.	Date.	Stars' Names.	Microm.	Level. N.	Level. S.	Mer.	Cl.	Barom. At. Therm.	Apparent δ and δ'	Corrections. Microm.	Corrections. Level.	Corrections. Refr.	Corrections. Mer.	Seconds of Lat.
	1886		r	d	d	sec.		°	° ′ ″	′ ″	″	″		″
98	Dec. 9	B. A. C. 8348	28.877	10.8	2.5		W.	36.8	—37 51 42.62	+2 15.79	+5.78	+1.20	—0.12	47.95
		δ Urs.maj. S. P. *	22.847	8.7	6.1				+122 20 32.99					
99	9	ε Androm.	24.214	4.2	10.1				28 41 57.65	—1 45.78	—1.01	—0.03	—0.05	48.81
		α Cass.	28.911	9.2	5.2		E.		55 55 13.62					
100	9	B.A.C. 341	34.590	6.2	7.1		E.		15 4 16.82	—5 55.10	+0.21	—0.12	—0.01	45.76
		38 Cass.	18.822	7.4	6.1				69 41 6.61					
101	9	ν Androm.	21.257	7.7	5.9				40 50 28.82	—2 51.60	+4.24	—0.05		48.98
		B.A.C. 492	28.877	9.9	3.7				43 48 44.0[illegible]					
102	9	φ Persei	26.636	5.9	7.[illegible]			34.5	50 7 14.2[illegible]	—0 25.98	+0.85	—0.01		46.82
		β Triang.	25.482	8.5	5.[illegible]		W.	29.175	34 27 9.7[illegible]					
103	9	31 Pegasi	30.857	6.5	6.[illegible]		E.	45.0	11 38 14.8[illegible]	—4 10.31	—0.37	—0.09	+0.03	47.99
		31 Ceph. †	19.742	6.1	6.8	[20]			73 3 42.64					
104	10	α Pisc. austr.	13.624	6.4	6.7		W.	43.5	—30 13 26.85	—8 6.33	—0.11	—1.45		48.40
		Gr. 1771, S. P.‡	35.219	6.7	6.6				+115 3 19.46					

105	10	B. A. C. 8195	28.174	12.0	1.3	[6]			38	37	7.14	+2	43.39[4]	+2.97	+0.05		48.60
		ζ Androm.	30.429	4.6	9.7				45	50	57.24						
106	10	B. A. C. 79	26.287	6.9	6.7		W.		51	23	47.89	+1	54.35	+0.74	+0.03		46.87
		π Androm.	21.209	7.3	6.1				33	5	55.61						
107	10	B.A.C.192§	12.998	6.0	7.7	[15]			—39	5	15.46	+6	35.55	—7.15	+3.96	—0.03	47.26
		B.A.C.202[1]	16.097	6.1	7.5				—39	2	57.32	+5	25.75	—7.00	+3.27		46.56
		ϵ Urs. maj., S. P.[2]	30.562	0.7	12.5				+123	25	45.27						
108	10	B. A. C. 341	34.520	4.2	11.3				15	4	16.89	—5	51.66	—2.60	—0.12		47.45
		38 Cass.	18.905	8.9	6.7		W.		69	41	6.78						
109	10	ϕ Persei	25.661	9.5	6.2			39.8	50	7	14.20	—0	25.51	+1.43	—0.01		47.85
		β Trian.	24.528	7.6	8.2				34	27	9.77						
110	16	α Pisc. austr.	36.992	6.1	7.4	[15]	E.	28.980 11.5	—30	13	27.06	—8	6.46	—1.70	—1.52		46.86
		Gr. 1771, S. P.[3]	15.391	5.5	7.4				+115	3	20.15						
111	16	B. A. C. 8195	29.789	6.8	6.2		W.		38	37	6.87	+2	47.75	—1.38	+0.05		48.39
		ζ Androm.	22.340	4.9	8.1	[3]			45	50	57.07						
112	16	B. A. C. 8348	23.183	7.7	5.7				—37	51	43.15	+2	22.44	—1.06	+1.25		48.25
		δ Urs. maj., S. P.	29.508	4.3	8.3				+122	20	34.40						

* Hazy in north. † Full moon. Hazy sky. ‡ Both stars flaring. § Est. Mag. 5.0. [1] Est. Mag. 5.3. Poorly bisected. [2] Flaring [3] High wind. [4] Microm. changed 5 rev.

Observations for Latitude. *Reductions.*

No.	Date.	Stars' Names.	Microm.	Level. N.	Level. S.	Mer.	Cl.	Barom. At. Therm.	Apparent δ and δ'	Corrections. Microm.	Corrections. Level.	Corrections. Refr.	Corrections. Mer.	Seconds of Lat.
	1886		r	d	d	sec.			° ′ ″	′ ″	″	″		″
113	Dec. 16	B. A. C. 341	34,182	5.8	6.2	[20]			15 4 16.65	−5 57.42	−1.38	−0.12	+0.03	43.32
		38 Cass.	18,311	4.9	7.1		W.		69 41 7.77					
114	16	φ Pegasi	24.938	1.3	10.6	[10]	E.	8.0	50 6 15.00	−0 22.32	−1.85	−0.01	+0.01	48.39
		β Triang.	23.947	8.9	3.1			7.0	34 27 10.13					
	1887							29.405						
115	Jan. 3	ε Androm.	26,123	6.2	9.8			3.8	28 41 56.71	−1 53.84	+6.52	−0.05		48.13
		α Cass.	21,068	16.0	0.1				55 55 14.25					
116	5	2 Ceti *	24,124	4.1	8.1				−17 58 4.46	+1 52.76	−3.50	+0.19	+0.01	47.73
		Gr. 1852, S.P.	29,131	5.7	8.3	[15]	W.	19.0	+102 28 1.00					
117	5	B. A. C. 79	25,813	7.0	6.6				51 23 47.66	+1 58.13	−0.95	+0.05		48.39
		π Androm.	20,567	5.8	8.0				33 5 54.70					
118	5	ε Androm.	26,009	8.3	5.6	[15]			28 41 56.55	−1 48.30	+1.53	−0.05	+0.03	48.58
		α Cass.	21,200	7.0	6.8				55 55 14.15					
119	5	B.A.C. 202	32,092	3.0	10.8	[10]		17.3	−39 2 59.30	+5 19.97	−0.16	+3.35	+0.05	48.70
		ε Urs. maj. S.P.	17,884	10.4	2.9	24	E.		+123 25 50.30					

120	5	φ Persei	26.214	0.1	13.7				50	7	16.07	—0	23.31	—0.05	—0.01		49.95
		β Triang.	25.179	13.7	0.2		W.	15.0	34	27	10.58						
121	5	17 Tauri	23.588	9.1	5.4				23	45	21.70	+0	44.93	+2.65	+0.01	+0.05	47.81
		η Tauri	23.762	9.1	5.4				23	45	13.30	+0	48.84	+2.65	+0.01	+0.05	48.02
		27 Tauri †	27.512	10.0	4.7	[21]			23	42	20.45	+2	13.30	+3.50	+0.04	+0.09	46.99
		9 H. Cam.	21.593	8.0	6.7	20	E.	29.370 8.6	60	46	39.64						
122	7	B.A.C. 79	28.361	7.0	7.3				51	23	47.50	+1	58.47	+0.11	+0.03		49.63
		π Androm ‡	23.100	7.3	6.8				33	5	54.54						
123	7	ε Androm.	26.862	4.1	10.0				28	41	56.39	—1	46.59	+0.11	—0.03		48.76
		α Cass.	22.129	10.0	3.9				55	55	14.04						
124	7	η Tauri	26.424	7.1	7.7	[13]			+23	45	13.30	+0	50.35[3]	+1.38	+0.01		48.37
		27 Tauri	27.242	7.0	7.7	[5]			23	42	20.49	+2	16.33	+1.32	+0.04	+0.02	47.93
		9 H. Cam.	21.188	9.0	5.8			29.360 1.7	60	46	39.96						
125	10	ε Androm.	22.192	10.8	+0.2	[18]			28	41	56.11	—1	50.91	+5.25	—0.03	+0.09	49.47
		α Cass.§	27.117	4.7	5.8	[21]		28.825 6.7	55	55	13.82						
126	10	ν Androm.	20.636	3.3	10.7	[21]			40	50	29.54	—2	54.77	+3.07	—0.05	+0.12	45.67
		B.A.C. 492	28.397	13.5	0.3	[20]			43	48	45.10						
127	10	φ Persei [1]	25.669	7.4	6.8	10	E.		50	7	16.06	—0	29.77[4]	+1.75	—0.01	+0.01	45.27
		β Triang. [2]	25.347	8.4	5.7			3.8	34	27	10.52						

*Con. des Temps. †5 sec. from edge of field. ‡Zenith-level working badly. § High wind. [1] Trouble with level.
[2] Microm. reading checked. [3] Microm. changed 3 rev. [4] Microm. changed 1 rev.

Observations for Latitude. — *Reductions.*

No.	Date.	Stars' Names.	Microm.	Level. N.	Level. S.	Mer.	Cl.	Barom. At. Therm.	Apparent δ and δ'	Corrections. Microm.	Corrections. Level.	Corrections. Refr.	Corrections. Mer.	Seconds of Lat.
	1887		r	d	d	sec.			° ′ ″	′ ″	″	″	″	″
128	Jan. 18	ε Androm.	25.832	11.1	4.1	[-9]			28 41 55.31	−1 50.82	+4.13	−0.03	+0.03	47.50
		α Cass.*	20.911	8.5	7.7	[14]		°	55 55 13.07					
								8.5 29.140	50 7 15.45					
129	24	φ Persei	23.910	5.6	6.2		W.	28.870		−0 25.17	+0.16	−0.01		47.69
		β Triang.	25.028	6.6	5.7			33.5	34 27 9.97					
130	24	20 H. Urs. min., S.P.	38.508	4.8	8.2			31.0	113 37 14.48	+11 19.32	−0.11	+1.81		48.30
		12 Erid.†	8.343	8.2	5.0		E.		−29 26 19.92					
131	24	17 Tauri	26.801	6.7	6.7				+23 45 21.60	+0 46.23	−0.42	+0.01		47.68
		η Tauri	25.616	6.7	6.7				23 45 13.22	+0 50.39[1]	−0.42	+0.01		47.65
		27 Tauri ‡	22.800	6.7	6.7	[13]			23 42 20.41	+2 16.33	−0.42	+0.04	+0.02	47.24
		9 H. Cam.	28.854	6.3	7.1			28.880 30.8	60 46 42.13					
132	26	Gr. 2164, S. P.	30.154	7.2	7.8				120 14 59.89	+4 30.64	−1.38	+1.69		49.72
		B. A. C. 923 §	18.136	5.8	7.8				−35 50 22.34					
133	26	2 H. Urs. min., S.P.	11.399	8.9	4.9	[10]		12.5	+113 37 14.75	+11 20.20	−1.17	+1.89		48.26
		12 Eridani	41.603	3.8	10.0		W.		−29 26 20.06					

134		26	17 Tauri	26.397	7.0	7.7				+23	45	21.57	+0	47.00	+0.90	+0.01		49.86
			η Tauri	26.243	7.0	7.7				23	45	13.19	+0	50.46	+0.90	+0.01		49.13
			27 Tauri	22.547	9.2	5.4				23	42	20.38	+2	13.70	+3.29	+0.04		48.38
			9H.Camel.	28.484	8.5	6.1			29.310 9.5	60	46	42.33						
135		29	γ Arietis, s.	31.816	7.7	6.7		E.	28.840 39.7	18	44	17.89						
			star										—5	15.95	+0.26	—0.10		47.55
			50 Cass.	17.786	7.2	7.7				65	59	48.79						
136		29	17 Tauri	25.520	2.9	11.9				23	45	21.50	+0	46.97	—0.64	+0.01		48.36
			η Tauri	25.812	0.7	14.2				23	45	13.13	+0	53.55	—3.02	+0.01		48.37
			27 Tauri	29.581	2.0	12.8				23	42	20.32	+2	18.43	—1.64	+0.04		48.26
			9H.Camel.	23.434	11.3	3.5			28.005 35.2	60	46	42.54						
137	Feb.	9	η Tauri	23.572	5.8	8.3			29.290 35.3	23	45	12.84						
			9 H.Camelop.[2]	21.362	8.6	5.5		E.		60	46	43.05	+0	49.76	+0.32	+0.01		48.03
138		9	Gr. 966	18.434	5.9	9.2				74	58	6.23						
			ϕ1 Orionis	32.995	8.9	6.2			32.8	9	24	31.97	+5	27.91	—0.32	+0.13		46.82

* Obs. hurried. † Stars very steady and well obs. ‡ Obs. poor. Hazy. § Setting 77° 58′. [1] Microm. changed 1 rev.
[2] Stars steady and well obs.

DISCUSSION OF THE RESULTS OF THE OBSERVATIONS FOR LATITUDE.

The following observations were rejected, either for failure to fall within an assumed limit or for reasons noted during the making of them: namely, 1, 17, 29, 31, 53, 66, 69, 70, 76, 84, 92, 96, second part of 107, 113, 127.

Weights were assigned to the observations on the following considerations:

First, the atmospheric and other physical conditions.

Second, the probability of the adopted star-places. Where both stars are standard stars the weight 140 was given, as also where B. A. C. 7657 was used. The weights of observations in which B. A. C. stars were used were, in this respect, made approximately proportional to the weights of the star-places given in the Table of Star-Places, pp. 12–18.

Third, the zenith-distance.

Fourth, the exactness with which the observation was made.

Fifth, the star's hour-angle at bisection.

The adopted weights were then taken approximately proportional to the product of the foregoing separate weights, for each star. In observations like 121, where one star is combined with each of two or more, the weight of each result is found by dividing the weight of the whole observation by the number of separate results.

The equations of condition were thus formed:

Let δ, δ' = the declinations of the stars,

" R = the true value of one revolution of the micrometer-screw,

" D = the true value of one division of the zenith-level,

" ϕ = the true value of the latitude,

" R_0, D_0, ϕ_0 = assumed values of the same quantities,

" $R = R_0 + x$, $D = D_0 + y$, $\phi = \phi_0 + z$,

Let ρ = the difference of refraction,
" μ = the meridian correction,
" $M = \frac{1}{2}(m' - m)$, where m', m are the micrometer-readings,
" $L = \frac{1}{4}[(n' + n) - (s' + s)]$, where n', n, etc., are the level-readings,

Then $\frac{1}{2}(\delta + \delta') + MR + LD + \rho + \mu - \phi = 0.$

Also by obs. 1,

$$\frac{1}{2}(\delta + \delta') + MR_0 + LD_0 + \rho + \mu - \phi_1 = 0,$$

whence $Mx + Ly - z + (\phi_1 - \phi_0) = 0.$

φ_0 was found by taking the mean of the results from pairs of standard stars of zenith-distance less than 30°, and difference of zenith-distance less than 11′; the level-correction being less than 1″.

$\varphi_0 = 42° 16' 47.87''$.

The observations were divided into five sets, according to temperature, and as many sets of normal equations were formed.

In order to reduce M, νx was substituted for x in the equation of condition, where $\nu = 10$.

Temperature 60°–75°.

No.	M	L	n	$\sqrt{\text{wt.}}$	Equations Weighted.
5	−8.84	−1.27	+0.26	1.0	$-0.88\,vx - 1.27\,y - z + 0.26 = 0$
6	−14.27	−0.17	−1.42	.9	$-1.28\,vx - 0.15\,y - 0.90\,z - 1.28 = 0$
7	+7.52	+2.35	+0.02	.9	$+0.68\,vx + 2.11\,y - 0.90\,z + 0.02 = 0$
8	−8.89	−0.30	+0.31	1.0	$-0.89\,vx - 0.30\,y - z + 0.31 = 0$
9	−10.01	−1.17	+0.61	1.0	$-1.00\,vx - 1.17\,y - z + 0.61 = 0$
10	+13.63	−0.32	+0.06	.7	$+0.95\,vx - 0.22\,y - 0.70\,z + 0.04 = 0$
11	−1.08	−0.15	−1.27	.6	$-0.06\,vx - 0.09\,y - 0.60\,z - 0.76 = 0$
12	−1.03	−0.02	+1.01	.6	$-0.06\,vx - 0.01\,y - 0.60\,z + 0.61 = 0$
13	−10.12	−0.05	−1.54	1.0	$-1.01\,vx - 0.05\,y - z - 1.54 = 0$
14	−3.81	0.00	+1.54	1.0	$-0.38\,vx + 0.00\,y - z + 1.54 = 0$
15	+0.39	+0.05	−1.58	.4	$+0.02\,vx + 0.02\,y - 0.40\,z - 0.63 = 0$
16	−10.18	+1.60	−0.55	.6	$-0.61\,vx + 0.96\,y - 0.60\,z - 0.33 = 0$
18	−10.68	−0.52	−0.01	.4	$-0.43\,vx - 0.21\,y - 0.40\,z - 0.00 = 0$
19	+0.54	−2.32	+0.54	.8	$+0.04\,vx - 1.86\,y - 0.80\,z + 0.43 = 0$
20	−8.92	−0.20	−0.85	.9	$-0.80\,vx - 0.18\,y - 0.90\,z - 0.76 = 0$
21	+13.60	−0.17	−0.15	.9	$+1.22\,vx - 0.15\,y - 0.90\,z - 0.13 = 0$
22	−3.84	−0.30	−0.03	.9	$-0.35\,vx - 0.27\,y - 0.90\,z - 0.03 = 0$
23	−8.95	−0.07	−1.40	1.0	$-0.89\,vx - 0.07\,y - z - 1{:}40 = 0$
24	−10.09	−0.17	−0.05	1.0	$-1.01\,vx - 0.17\,y - z - 0.05 = 0$
25	+13.62	−0.15	+1.10	1.0	$+1.36\,vx - 0.15\,y - z + 1.10 = 0$
26	−3.89	−0.07	−1.16	1.0	$-0.39\,vx - 0.07\,y - z - 1.16 = 0$

NORMAL EQUATIONS.

$$+13.363\,vx + 3.571\,y + 5.472\,z + 5.462 = 0,$$
$$+3.571\,vx + 12.218\,y + 3.228\,z - 1.717 = 0,$$
$$+5.472\,vx + 3.228\,y - 15.580\,z + 2.460 = 0.$$

SOLUTION.

$$vx + [9.42688]\,y + [9.61224]\,z + [9.61168] = 0,$$
$$y + [9.19529]\,z + [9.45045] = 0,$$
$$z + [8.74132] = 0.$$

The numbers in brackets are logarithms.

Value.	Weight.	Probable Error.
$x = -0.0464''$	1093	$0.0157''$
$y = +0.2908$	11	0.1551
$z = -0.0551$	13	0.1426

$$m = 21,\ \mu = 3,\ [nn\cdot 3] = 10.502,$$

$$r = 0.6745\sqrt{\frac{[nn\cdot 3]}{m-\mu}} = 0.5152''.$$

Temperature 45°-60°.

No.	M	L	n	$\sqrt{wt.}$	Equations Weighted.
2	+7.60	+1.52	+1.78	0.9	$+0.68\,vx + 1.37\,y - 0.90\,z + 1.60 = 0$
3	−5.48	−0.22	−0.54	.9	$-0.49\,vx - 0.20\,y - 0.90\,z - 0.49 = 0$
4	−2.98	−1.27	+0.88	.7	$-0.21\,vx - 0.89\,y - 0.70\,z + 0.62 = 0$
4	−9.06	−0.20	−0.56	.7	$-0.63\,vx - 0.14\,y - 0.70\,z - 0.39 = 0$
27	+7.60	−0.05	+0.33	.6	$+0.46\,vx - 0.03\,y - 0.60\,z + 0.20 = 0$
28	−16.54	0.00	−1.67	1.0	$-1.64\,vx + 0.00\,y - z - 1.67 = 0$
30	−18.48	+0.47	+1.34	.9	$-1.66\,vx + 0.40\,y - 0.90\,z + 1.21 = 0$
32	−8.96	+0.42	−0.67	1.0	$-0.90\,vx + 0.42\,y - z - 0.67 = 0$
33	−10.10	+0.02	+0.16	1.0	$-1.01\,vx + 0.02\,y - z + 0.16 = 0$
34	+13.58	−0.50	−1.26	1.0	$+1.36\,vx - 0.50\,y - z - 1.26 = 0$
35	−3.87	−0.15	−0.26	1.0	$-0.39\,vx - 0.15\,y - z - 0.26 = 0$
36	+7.61	−0.22	+0.78	.9	$+0.68\,vx - 0.20\,y - 0.90\,z + 0.70 = 0$
37	−5.63	+2.30	+0.25	.9	$-0.51\,vx + 2.07\,y - 0.90\,z + 0.22 = 0$
38	−10.85	+1.87	−1.24	.4	$-0.43\,vx + 0.75\,y - 0.40\,z - 0.50 = 0$
39	−8.93	−0.17	−0.44	1.0	$-0.89\,vx - 0.17\,y - z - 0.44 = 0$
40	−10.11	+0.12	−0.16	1.0	$-1.01\,vx + 0.12\,y - z - 0.16 = 0$
41	+13.62	−0.05	+1.49	1.0	$+1.36\,vx - 0.05\,y - z + 1.49 = 0$
42	−3.88	0.00	−0.12	1.0	$-0.39\,vx + 0.00\,y - z - 0.12 = 0$
43	+7.56	+0.17	−0.10	.9	$+0.68\,vx + 0.15\,y - 0.90\,z - 0.09 = 0$
44	−5.56	+0.07	−0.11	.9	$-0.50\,vx + 0.06\,y - 0.90\,z - 0.10 = 0$
45	−10.84	+1.67	−0.38	.4	$-0.43\,vx + 0.67\,y - 0.40\,z - 0.15 = 0$
46	+6.96	−0.15	+0.92	1.0	$+0.70\,vx - 0.15\,y - z + 0.92 = 0$
47	+8.76	−0.17	−1.29	.9	$+0.79\,vx - 1.53\,y - 0.90\,z - 1.16 = 0$
48	+7.57	−0.37	−0.51	.9	$+0.68\,vx - 0.33\,y - 0.90\,z - 0.46 = 0$
49	−5.52	+0.05	+1.61	.9	$-0.50\,vx + 0.04\,y - 0.90\,z + 1.45 = 0$
50	−12.08	+0.22	+0.93	.6	$-0.72\,vx + 0.13\,y - 0.60\,z + 0.56 = 0$

NORMAL EQUATIONS.

$$+18.596\,vx - 3.813\,y + 4.033\,z + 2.640 = 0,$$
$$-3.813\,vx + 11.238\,y - 1.094\,z + 4.382 = 0,$$
$$+4.033\,vx - 1.094\,y + 20.120\,z - 0.939 = 0.$$

SOLUTION.

$$vx + [9.31885\,n]\,y + [9.33621]\,z + [9.15218] = 0,$$
$$y + [8.40714\,n]\,z + [9.67286] = 0,$$
$$z + [8.85759\,n] = 0.$$

Value.	Weight.	Probable Error.
$x = -0''.0254$	1663	$0''.0134$
$y = -0.4689$	10	0.1689
$z = +0.0720$	19	0.1245

$$m = 26,\ \mu = 3,\ [nn \cdot 3] = 15.069,$$
$$r = 0''.5459.$$

Temperature 30°–45°.

No.	M	L	n	$\sqrt{\text{wt.}}$	Equations Weighted.
51	+13.60	—0.55	—0.40	1.00	$+ 1.36\ vx - 0.55\ y - \ z - 0.40 = 0$
52	+7.66	—1.95	+0.38	.90	$+ 0.69\ vx - 1.75\ y - 0.90\ z + 0.34 = 0$
54	—10.80	—0.10	—1.84	.40	$- 0.43\ vx - 0.04\ y - 0.40\ z - 0.74 = 0$
55	—12.13	+0.22	—0.88	.90	$- 1.09\ vx + 0.20\ y - 0.90\ z - 0.79 = 0$
56	—8.92	—0.10	—0.19	1.00	$- 0.89\ vx - 0.10\ y - \ z - 0.19 = 0$
57	—10.13	+0.37	—0.35	1.00	$- 1.01\ vx + 0.37\ y - \ z - 0.35 = 0$
58	+13.56	0.00	—0.66	.70	$+ 0.95\ vx + 0.00\ y - 0.70\ z - 0.46 = 0$
59	—3.90	+0.15	—0.49	1.00	$- 0.39\ vx + 0.15\ y - \ z - 0.49 = 0$
60	—5.56	—0.22	—0.39	.90	$- 0.50\ vx - 0.20\ y - 0.90\ z - 0.35 = 0$
61	—10.77	—0.32	—0.63	.40	$- 0.43\ vx - 0.13\ y - 0.40\ z - 0.25 = 0$
62	—12.12	+0.02	—0.39	.60	$- 0.73\ vx + 0.01\ y - 0.60\ z - 0.23 = 0$
63	+6.94	—0.40	+0.94	.70	$+ 0.49\ vx - 0.28\ y - 0.70\ z + 0.66 = 0$
64	+7.55	+0.10	+0.15	.90	$+ 0.68\ vx + 0.09\ y - 0.90\ z + 0.13 = 0$
65	—9.22	+0.50	—0.57	1.00	$- 0.92\ vx + 0.50\ y - \ z - 0.57 = 0$
67	—12.34	0.00	—0.50	.20	$- 0.25\ vx + 0.00\ y - 0.20\ z - 0.10 = 0$
68	+2.17	0.00	—2.30	.08	$+ 0.02\ vx + 0.00\ y - 0.08\ z - 0.18 = 0$
71	+6.88	—0.22	—0.34	.20	$+ 0.14\ vx - 0.04\ y - 0.20\ z - 0.07 = 0$
71	—2.37	+0.15	—0.58	.20	$- 0.05\ vx + 0.03\ y - 0.20\ z - 0.12 = 0$
72	—3.89	—0.45	—1.57	1.00	$- 0.39\ vx - 0.45\ y - \ z - 1.57 = 0$
88	+7.59	—0.05	+1.14	.90	$+ 0.68\ vx - 0.04\ y - 0.90\ z + 1.03 = 0$
89	—5.53	—0.47	+0.59	.90	$- 0.50\ vx - 0.42\ y - 0.90\ z + 0.53 = 0$
90	+3.69	—0.55	—0.35	.50	$+ 0.18\ vx - 0.27\ y - 0.50\ z - 0.17 = 0$
91	+3.15	—0.22	—0.35	.08	$+ 0.03\ vx - 0.02\ y - 0.08\ z - 0.03 = 0$
97	+3.67	—0.05	—0.43	.50	$+ 0.18\ vx - 0.02\ y - 0.50\ z - 0.21 = 0$
98	+3.01	+2.72	+0.08	.08	$+ 0.02\ vx + 0.22\ y - 0.08\ z + 0.01 = 0$
99	—2.35	—0.47	+0.94	.90	$- 0.21\ vx - 0.42\ y - 0.90\ z + 0.85 = 0$
100	—7.88	+0.10	—2.11	.30	$- 0.24\ vx + 0.03\ y - 0.30\ z - 0.63 = 0$

Temperature 30°–45°. Concluded.

No.	M	L	n	$\sqrt{\text{wt.}}$	Equations Weighted.
101	−3.81	+2.00	+1.11	.20	$-0.08\,vx+0.40\,y-0.20\,z+0.22=0$
102	−0.58	+0.40	−1.05	.90	$-0.05\,vx+0.36\,y-0.90\,z-0.94=0$
103	−5.56	−0.17	+0.12	.60	$-0.33\,vx-0.10\,y-0.60\,z+0.07=0$
104	−10.80	−0.05	+0.53	.30	$-0.32\,vx-0.01\,y-0.30\,z+0.16=0$
105	+3.63	+1.40	+0.73	.50	$+0.18\,vx+0.70\,y-0.50\,z+0.36=0$
106	+2.54	+0.35	−1.00	.20	$+0.05\,vx+0.07\,y-0.20\,z-0.20=0$
107	+8.78	−3.37	−0.61	.05	$+0.04\,vx-0.17\,y-0.05\,z-0.03=0$
108	−7.81	−1.22	−0.42	.30	$-0.23\,vx-0.37\,y-0.30\,z-0.13=0$
109	−0.57	+0.67	−0.02	.90	$-0.05\,vx+0.60\,y-0.90\,z-0.02=0$
129	−0.56	+0.07	−0.18	1.00	$-0.06\,vx+0.07\,y-z-0.18=0$
130	+15.08	−0.05	+0.43	.40	$+0.60\,vx-0.02\,y-0.40\,z+0.17=0$
131	+1.03	−0.20	−0.19	.30	$+0.03\,vx-0.06\,y-0.30\,z-0.06=0$
131	+1.12	−0.20	−0.22	.20	$+0.02\,vx-0.04\,y-0.20\,z-0.04=0$
131	+3.03	−0.20	−0.63	.20	$+0.06\,vx-0.04\,y-0.20\,z-0.13=0$
135	−7.01	+0.12	−0.32	1.00	$-0.70\,vx+0.12\,y-z-0.32=0$
136	+1.04	−0.30	+0.49	.40	$+0.04\,vx-0.12\,y-0.40\,z+0.20=0$
136	+1.19	−1.42	+0.50	.30	$+0.04\,vx-0.43\,y-0.30\,z+0.15=0$
136	+3.07	−0.77	+0.39	.30	$+0.09\,vx-0.23\,y-0.30\,z+0.12=0$
137	+1.10	+0.15	+0.16	1.00	$+0.11\,vx+0.15\,y-z+0.16=0$
138	+7.28	−0.15	−1.05	.90	$+0.66\,vx-0.13\,y-0.90\,z-0.94=0$

NORMAL EQUATIONS.

$$
\begin{aligned}
+11.829\,vx-2.556\,y+2.260\,z+3.290&=0,\\
-2.556\,vx+6.290\,y+1.685\,z-0.920&=0,\\
+2.260\,vx+1.685\,y+21.032\,z+4.490&=0.
\end{aligned}
$$

SOLUTION.

$$
\begin{aligned}
vx+[9.33462n]\,y+[9.28117]\,z+[9.44426]&=0,\\
y+[9.57830]\,z+[8.56139n]&=0,\\
z+[9.29934]&=0.
\end{aligned}
$$

Value.	Weight.	Probable Error.
″		″
$x=-0.0216$	1037	0.0093
$y=+0.1119$	6	0.1281
$z=-0.1992$	20	0.0676

$m=47,\ \mu=3,\ [nn\cdot 3]=8.749,\ r=0.3008.$ ″

Temperature 15°–30°.

No.	M	L	n	$\sqrt{\text{wt.}}$	Equations Weighted.
75	+7.57	−0.10	+0.34	0.90	$+0.68\,vx - 0.09\,y - 0.90\,z + 0.31 = 0$
77	+2.52	+0.75	+0.90	.20	$+0.05\,vx + 0.15\,y - 0.20\,z + 0.18 = 0$
78	−9.17	−0.75	−0.23	1.00	$-0.92\,vx - 0.75\,y - z - 0.23 = 0$
79	+3.66	+0.45	+0.13	.50	$+0.18\,vx + 0.22\,y - 0.50\,z + 0.06 = 0$
80	+2.26	+0.65	+1.20	.30	$+0.07\,vx + 0.19\,y - 0.30\,z + 0.36 = 0$
81	−0.52	+0.47	+1.55	1.00	$-0.05\,vx + 0.47\,y - z + 1.55 = 0$
82	+2.29	−1.62	+0.01	.20	$+0.05\,vx - 0.32\,y - 0.20\,z + 0.00 = 0$
83	+2.49	+0.25	−1.53	.20	$+0.05\,vx + 0.05\,y - 0.20\,z - 0.31 = 0$
85	+3.69	−0.30	−0.17	.50	$+0.18\,vx - 0.15\,y - 0.50\,z - 0.08 = 0$
86	+2.26	+0.02	−0.24	.30	$+0.07\,vx + 0.01\,y - 0.30\,z - 0.07 = 0$
87	−7.91	+0.50	−1.60	.40	$-0.32\,vx + 0.20\,y - 0.40\,z - 0.64 = 0$
93	−7.86	−0.05	−0.58	.40	$-0.31\,vx - 0.02\,y - 0.40\,z - 0.23 = 0$
94	−0.54	+0.05	−0.39	1.00	$-0.54\,vx + 0.05\,y - z - 0.39 = 0$
95	+7.59	−0.15	+0.62	.80	$+0.61\,vx - 0.12\,y - 0.80\,z + 0.50 = 0$
116	+2.50	−1.65	−0.14	.70	$+0.17\,vx - 1.15\,y - 0.70\,z - 0.10 = 0$
117	+2.62	−0.45	+0.52	.30	$+0.08\,vx - 0.13\,y - 0.30\,z + 0.16 = 0$
118	−2.40	+0.72	+0.71	.70	$-0.17\,vx + 0.50\,y - 0.70\,z + 0.50 = 0$
119	+7.10	−0.07	+0.83	.06	$+0.04\,vx - 0.00\,y - 0.06\,z + 0.05 = 0$

NORMAL EQUATIONS.

$$+2.321\,vx + 0.177\,y + 0.384\,z + 1.060 = 0,$$
$$+0.177\,vx + 2.673\,y + 0.758\,z + 1.119 = 0,$$
$$+0.384\,vx + 0.758\,y + 6.644\,z - 1.643 = 0.$$

SOLUTION.

$$vx + [8.88229]\,y + [9.21865]\,z + [9.65963] = 0,$$
$$y + [9.43785]\,z + [9.59132] = 0,$$
$$z + [9.51774n] = 0.$$

Value.	Weight.	Probable Error.
$''$		$''$
$x = -\,0.0475$	191	0.0195
$y = -\,0.4805$	3	0.1679
$z = +\,0.3294$	6	0.1067

$$m = 18,\quad \mu = 3,\quad [nn \cdot 3] = 2.396,\quad r = 0''.2696.$$

Temperature 0°–15°.

No.	M	L	n	$\sqrt{wt.}$	Equations Weighted.
73	—12.30	—1.52	—1.24	0.30	$-0.37\,vx - 0.46\,y - 0.30\,z - 0.37 = 0$
74	+3.80	—2.50	—0.93	.50	$+0.19\,vx - 1.25\,y - 0.50\,z - 0.46 = 0$
110	—10.80	—0.80	—1.01	.30	$-0.32\,vx - 0.24\,y - 0.30\,z - 0.30 = 0$
111	+3.72	—0.65	+0.52	.50	$+0.19\,vx - 0.32\,y - 0.50\,z + 0.26 = 0$
112	+3.16	—0.50	+0.38	.08	$+0.03\,vx - 0.04\,y - 0.08\,z + 0.03 = 0$
114	—0.50	—0.87	+0.52	.90	$-0.04\,vx - 0.78\,y - 0.90\,z + 0.47 = 0$
115	—2.53	+3.07	+0.26	1.00	$-0.25\,vx + 3.07\,y - z + 0.26 = 0$
120	—0.52	—0.02	+2.08	1.00	$-0.05\,vx - 0.02\,y - z + 2.08 = 0$
121	+1.00	+1.25	—0.06	.30	$+0.03\,vx + 0.37\,y - 0.30\,z - 0.02 = 0$
121	+1.08	+1.25	+0.15	.20	$+0.02\,vx + 0.25\,y - 0.20\,z + 0.03 = 0$
121	+2.96	+1.65	—0.88	.20	$+0.06\,vx + 0.33\,y - 0.20\,z - 0.18 = 0$
122	+2.63	+0.05	+1.76	.20	$+0.05\,vx + 0.01\,y - 0.20\,z + 0.35 = 0$
123	—2.37	+0.05	+0.89	.60	$-0.14\,vx + 0.03\,y - 0.60\,z + 0.53 = 0$
124	+1.12	+0.65	+0.50	.30	$+0.03\,vx + 0.19\,y - 0.30\,z + 0.15 = 0$
124	+3.03	+0.62	+0.06	.30	$+0.09\,vx + 0.19\,y - 0.30\,z + 0.02 = 0$
125	—2.46	+2.47	+1.60	.40	$-0.10\,vx + 0.99\,y - 0.40\,z + 0.64 = 0$
126	—3.88	+1.45	—2.20	.10	$-0.04\,vx + 0.14\,y - 0.10\,z - 0.22 = 0$
128	—2.46	+1.95	—0.37	.90	$-0.22\,vx + 1.75\,y - 0.90\,z - 0.33 = 0$
132	+6.01	—0.65	+1.85	.04	$-0.02\,vx - 0.03\,y - 0.04\,z + 0.07 = 0$
133	+15.10	—0.55	+0.39	.40	$+0.60\,vx - 0.22\,y - 0.40\,z + 0.16 = 0$
134	+1.04	+0.42	+1.99	.40	$+0.04\,vx + 0.17\,y - 0.40\,z + 0.80 = 0$
134	+1.12	+0.42	+1.26	.30	$+0.03\,vx + 0.13\,y - 0.30\,z + 0.38 = 0$
134	+2.97	+1.55	+0.51	.30	$+0.09\,vx + 0.46\,y - 0.30\,z + 0.15 = 0$

NORMAL EQUATIONS.

$$+0.846\,vx - 1.303\,y + 0.313\,z + 0.118 = 0,$$
$$-1.303\,vx + 16.720\,y - 3.852\,z + 1.358 = 0,$$
$$-0.313\,vx - 3.852\,y + 5.728\,z - 3.350 = 0.$$

SOLUTION.

$$vx + [0.18757n]\,y + [9.56817]\,z + [9.14451] = 0,$$
$$y + [9.35993n]\,z + [9.01982] = 0,$$
$$z + [9.79817n] = 0.$$

Value.	Weight.	Probable Error.
$x = -0''.0311$	74	$0''.0387$
$y = +0.0392$	13	0.0937
$z = +0.6283$	5	0.1517

$m = 23,\ \mu = 3,\ [nn \cdot 3] = 4.898,\ r = 0''.3338.$

As the results of the foregoing five sets of equations indicate no temperature-corrections to the values of R and D, the following set of equations was formed from all the observations.

NORMAL EQUATIONS FORMED FROM ALL THE OBSERVATIONS.

$$\begin{aligned} +\ 46.955\ vx - \ \ 3.924\ y + 12.462\ z + 12.573 &= 0, \\ -\ \ 3.924\ vx + 49.139\ y + \ \ 0.725\ z + \ \ 4.225 &= 0, \\ +\ 12.462\ vx + \ \ 0.725\ y + 69.104\ z + \ \ 1.018 &= 0. \end{aligned}$$

SOLUTION.

$$\begin{aligned} vx + [8.92205n]\ y + [9.42391]\ z + [9.42776] &= 0, \\ y + [8.55847]\ z + [9.03378] &= 0, \\ z + [8.58189n] &= 0. \end{aligned}$$

Value.	Weight.	Probable Error.
$x = -\ 0.''0287$	4437	$0.''0062$
$y = -\ 0.1095$	49	0.0588
$z = +\ 0.0382$	66	0.0506

$$m = 135,\ \ \mu = 3,\ \ [nn \cdot 3] = 48.922,\ \ r = 0.''4106.$$

Probable Values of R, D, φ.

Quantity.	Assumed Value.	Correction.	Probable Value.
R	$45.''0406$	$-\ 0.0287$	$45.''0119$
D	2.1192	$-\ 0.1095$	2.0097
φ	47.87	$+\ 0.04$	47.91

Taking 1'' of latitude = 101 ft., the difference of latitude of the two observatories is 75.3 ft. = 0.''75.

Adding this to the value above, the result is

Latitude of the Detroit Observatory, 42° 16′ 48.″66 ± 0.″051.

Values of Latitude Corrected by Computed Probable Values of R and D.

No.	Computed Value.	Microm. Cor.	Level. Cor.	Corrected Value.	No.	Computed Value.	Microm. Cor.	Level Cor.	Corrected Value.
	″	″	″	″		″	″	″	″
1	44.53	−0.36	−0.34	43.83	23	46.47	+0.26	+0.01	46.74
2	49.65	− .22	− .17	49.26	24	47.82	+ .29	+ .02	48.13
3	47.33	+ .16	+ .02	47.51	25	48.97	− .39	+ .02	48.60
4	48.75	+ .08	+ .14	48.97	26	46.71	+ .11	+ .01	46.83
4	47.31	+ .26	+ .02	47.59*	27	48.20	− .22	+ .01	47.99
5	48.13	+ .25	+ .14	48.52	28	46.20	+ .47	.00	46.67
6	46.45	+ .41	+ .02	46.88	29	52.95	+ .23	.00	53.18
7	47.89	− .22	− .26	47.41	30	49.21	+ .53	− .05	49.69
8	48.18	+ .26	+ .03	48.47	31	46.54	+ .26	+ .04	46.84
9	48.48	+ .29	+ .13	48.90	32	47.20	+ .26	− .05	47.41
10	47.93	− .39	+ .04	47.58	33	48.03	+ .29	.00	48.32
11	46.60	+ .03	+ .02	46.65	34	46.61	− .39	+ .05	46.27
12	48.88	+ .03	.00	48.91	35	47.61	+ .11	+ .02	47.74
13	46.33	+ .29	+ .01	46.63	36	48.65	− .22	+ .02	48.45
14	49.41	+ .11	.00	49.52	37	48.12	+ .16	− .25	48.03
15	46.29	+ .01	− .01	46.27	38	46.63	+ .31	− .20	46.74
16	47.32	+ .29	− .18	47.43	39	47.43	+ .26	+ .02	47.71
17	25.86	+ .21	+ .04	26.11	40	47.71	+ .29	− .01	47.99
18	47.86	+ .31	+ .06	48.23	41	49.36	− .39	+ .01	48.98
19	48.41	− .02	+ .25	48.64	42	47.75	+ .11	.00	47.86
20	47.02	+ .26	+ .02	47.30	43	47.77	− .22	− .02	47.53
21	47.72	− .39	+ .02	47.35	44	47.76	+ .16	− .01	47.91
22	47.84	+ .11	+ .03	47.98	45	47.49	+ .31	− .18	47.62

* Mean 48.″28.

Values of Latitude Corrected by Computed Probable Values of R and D.

No.	Computed Value.	Microm. Cor.	Level Cor.	Corrected Value.	No.	Computed Value.	Microm. Cor.	Level Cor.	Corrected Value.
	''	''	''	''		''	''	''	''
46	48.79	−0.20	+0.02	48.61	69	6.21	−0.08	0.00	6.13
47	46.58	− .25	+ .02	46.35	70	12.48	+ .36	.00	12.84
48	47.36	− .22	+ .04	47.18	71	47.53	− .20	+ .02	47.35
49	49.48	+ .16	− .01	49.63	71	47.29	+ .07	− .02	47.34*
50	48.80	+ .35	− .02	49.13	72	46.30	+ .11	+ .05	46.46
51	47.47	− .39	+ .06	47.14	73	46.63	+ .35	+ .17	47.15
52	48.25	− .22	+ .20	48.23	74	46.94	− .11	+ .25	47.08
53	44.80	+ .16	+ .05	44.01	75	48.21	− .22	+ .01	48.00
54	46.03	+ .31	+ .01	46.35	76	43.41	+ .16	+ .03	43.60
55	46.99	+ .35	− .02	47.32	77	48.77	− .07	− .08	48.62
56	47.68	+ .26	+ .01	47.95	78	47.64	+ .26	+ .08	47.98
57	47.52	+ .29	− .04	47.77	79	48.00	− .10	− .05	47.85
58	47.21	− .39	.00	46.82	80	49.07	− .06	− .07	48.94
59	47.38	+ .11	− .02	47.47	81	49.42	+ .01	− .05	49.38
60	47.48	+ .16	+ .02	47.66	82	47.88	− .07	+ .18	47.99
61	47.24	+ .31	+ .04	47.59	83	46.34	− .07	− .03	46.24
62	47.48	+ .35	.00	47.83	84	12.04	+ .36	.00	12.40
63	48.81	− .20	+ .04	48.65	85	47.70	− .10	+ .03	47.63
64	48.02	− .22	− .01	47.79	86	47.63	− .06	.00	47.57
65	47.30	+ .26	− .05	47.51	87	46.27	+ .23	− .05	46.45
66	49.31	+ .35	− .05	49.61	88	49.01	− .22	+ .01	48.80
67	47.37	+ .35	.00	47.72	89	48.46	+ .16	+ .05	48.67
68	45.57	− .06	.00	45.51	90	47.52	− .11	+ .06	47.47

* Mean 47.″34.

Values of Latitude Corrected by Computed Probable Values of R and D.

No.	Computed Value.	Microm. Cor.	Level Cor.	Corrected Value.	No.	Computed Value.	Microm. Cor.	Level Cor.	Corrected Value.
	″	″	″	″		″	″	″	″
91	47.52	−0.09	+0.02	47.45	113	43.32	+0.23	+0.07	43.62
92	50.90	+ .07	+ .05	51.02	114	48.39	+ .01	+ .10	48.50
93	47.29	+ .23	+ .01	47.53	115	48.13	+ .07	− .34	47.86
94	47.48	+ .02	− .01	47.49	116	47.73	− .07	+ .18	47.84
95	48.49	− .22	+ .02	48.29	117	48.39	− .07	+ .05	48.37
96	53.36	+ .15	+ .04	53.55	118	48.58	+ .07	− .08	48.57
97	47.44	− .10	+ .01	47.35	119	48.70	− .20	+ .01	48.51
98	47.95	− .09	− .29	47.57	120	49.95	+ .01	.00	49.96
99	48.81	+ .07	+ .05	48.93	121	47.81	− .03	− .14	47.64
100	45.76	+ .23	− .01	45.98	121	48.02	− .03	− .14	47.85
101	48.98	+ .11	− .22	48.87	121	46.99	− .08	− .18	46.73*
102	46.82	+ .02	− .04	46.80	122	49.63	− .07	− .01	49.55
103	47.99	+ .16	+ .02	48.17	123	48.76	+ .07	− .01	48.82
104	48.40	+ .31	+ .01	48.72	124	48.37	− .03	− .07	48.27
105	48.60	− .10	− .15	48.35	124	47.93	− .09	− .07	47.77†
106	46.87	− .07	− .04	46.76	125	49.47	+ .07	− .27	49.27
107	47.26	− .25	+ .37	47.38	126	45.67	+ .11	− .16	45.62
107	46.56	− .21	+ .36	46.71	127	45.27	+ .02	− .09	45.20
108	47.45	+ .22	+ .13	47.80	128	47.50	+ .07	− .21	47.36
109	47.85	+ .02	− .07	47.80	129	47.69	+ .02	− .01	47.70
110	46.86	+ .31	+ .09	47.26	130	48.30	− .43	+ .01	47.88
111	48.39	− .11	+ .07	48.35	131	47.68	− .03	+ .02	47.67
112	48.25	− .09	+ .05	48.21	131	47.65	− .03	+ .02	47.64

* Mean 47″.41 † Mean 48″.02.

Values of Latitude Corrected by Computed Probable Values of R and D.

No.	Computed Value.	Microm. Cor.	Level Cor.	Corrected Value.	No.	Computed Value.	Microm. Cor.	Level Cor.	Corrected Value.
	″	″	″	″		″	″	″	″
131	47.24	—0.09	+0.02	47.17*	135	47.55	+0.20	—0.01	47.74
132	49.72	— .17	+ .07	49.62	136	48.36	— .03	+ .03	48.36
133	48.26	— .43	+ .06	47.89	136	48.37	— .03	+ .16	48.50
134	49.86	— .03	— .05	49.78	136	48.26	— .09	+ .08	48.25‡
134	49.13	— .03	— .05	49.05	137	48.03	— .03	— .02	47.98
134	48.38	— .09	— .17	48.12†	138	46.82	— .21	+ .02	46.63

* Mean 47″.49. † Mean 48″.98. ‡ Mean 48″.37.

The following pairs, with the corrected latitudes furnished by them, were used to determine the probable error of an observation. The result is 0.″539.

Names.	No. of Obs.	Names.	No. of Obs.
γ Cygni α Cygni	7	γ Cephei c^2 Piscium	3
6 H. Cephei 32 Vulpeculæ	7	α Andromedæ α Cassiopeiæ	3
ν Cygni ξ Cygni	7	B. A. C. 79 π Andromedæ	3
Gr. 3415 κ Pegasi	7	ϵ Andromedæ α Cassiopeiæ	7
20 Pegasi 24 Cephei	11	B. A. C. 341 38 Cassiopeiæ	4
31 Pegasi 31 Cephei	7	ϕ Persei β Trianguli	7
τ Pegasi 4 Cassiopeiæ	3	17 Tauri, etc. 9 H. Camelopardalis (Mean values)	6
B. A. C. 8195 λ Andromedæ	7		

VALUES OF LATITUDE DEPENDING ON ZENITH-DISTANCE OF STARS OBSERVED.

In forming this table each observation received the same weight as the corresponding equation of condition; and the values here given are each the mean by weight of the separate values employed.

Temp.	0° — 20°	Wt.	20° — 40°	Wt.	60° — 81°	Wt.
	″		″		″	
45° — 75°	47.88	24	48.01	10	47.67	1
30 — 45	47.63	13	48.55	8	47.63	1
0 — 30	48.37	9	48.05	2	47.71	1

The smaller values obtained from the low stars seem to indicate that northern stars are refracted less than southern, for the same zenith-distance; and that, therefore, the layers of the atmosphere, instead of being parallel to the surface of the earth, are depressed more rapidly toward the north.

THE END.